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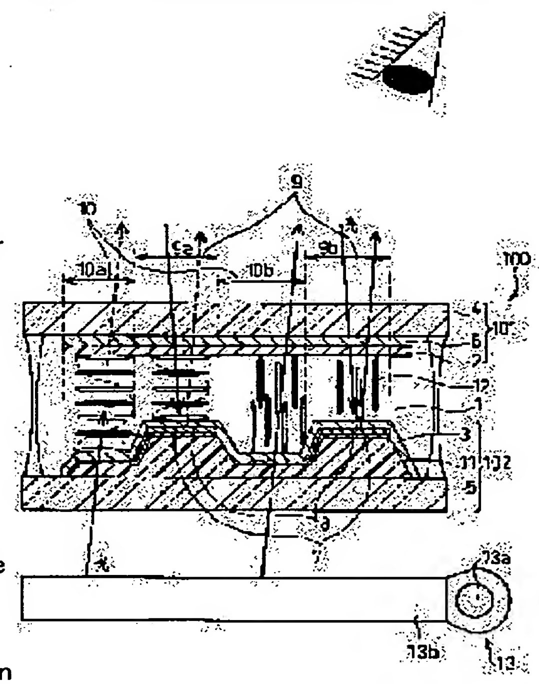
(54) LIQUID CRYSTAL DISPLAY DEVICE



(57)Abstract:

PROBLEM TO BE SOLVED: To improve visibility, to perform high resolution display and to utilize both reflected light and transmitted light for display.

SOLUTION: This liquid crystal display device is provided with a light crystal display element 100 provided with a pair of substrates 4 and 5 where alignment layers and 3 are formed on surfaces facing each other and a liquid crystal layer 1 clamped between the pair of the substrates 4 and 5. In this case, an orientation mechanism for making optional and different areas utilized for the display in the liquid crystal layer simultaneously take at least two kinds of different alignment states is provided. Also, a reflection film 8 is arranged in at least one of the areas for indicating the different alignment states in the liquid crystal layer 1 and the area for indicting the different alignment state is used for a reflection display part 9 for performing reflection display and a transmission display part 10 for performing transmission display. As the alignment mechanism, for instance, the alignment layers 2 and 3 subjected to alignment layer treatment in the different orientation for the reflection display part 9 and the transmission display part 10 and an insulation film 11 formed into different film thickness for the reflection display part 9 and the transmission display part 10, etc., are cited.

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CLAIMS

[Claim(s)]

[Claim 1] It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrate of a pair with which the orientation means was given to the front face which counters, and the substrate of this pair. It is arbitrary and the orientation device for making coincidence take at least two kinds of different orientation conditions is provided to a different field used for the display in the above-mentioned liquid crystal layer. And the liquid crystal display with which the field which shows an orientation condition which a reflective means is allotted to at least one field among the fields which show a different orientation condition in the above-mentioned liquid crystal layer, and is different the account of a top is characterized by being used for the reflective display which performs a reflective display, and the transparency display which performs a transparency display.

[Claim 2] The liquid crystal display according to claim 1 characterized by the above-mentioned orientation device being the contents rewriting means of a display which rewrites the contents of a display in connection with the passage of time.

[Claim 3] It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrate of a pair with which the orientation means was given to the front face which counters, and the substrate of this pair. While each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display It is the liquid crystal display characterized by allotting a reflective means to a reflective display at least, and the liquid crystal thickness of the above-mentioned reflective display being smaller than a transparency display.

[Claim 4] A liquid crystal display given in any 1 term of claims 1-3 characterized by giving the orientation means so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of a top Norikazu pair in the orientation of the liquid crystal layer interface which touches it.

[Claim 5] A liquid crystal display given in any 1 term of claims 1-4 to which the rate that the area of the reflective display to the area of the sum total of the above-mentioned reflective display and a transparency display occupies is characterized by being 30% or more and 90% or less.

[Claim 6] A liquid crystal display given in any 1 term of claims 1-5 characterized by for a reflective display serving as clear display at coincidence when the above-mentioned transparency display is clear display, and a reflective display serving as a dark display at coincidence when the above-mentioned transparency display is a dark display.

[Claim 7] A liquid crystal display given in any 1 term of claims 1-6 characterized by the above-mentioned liquid crystal layer consisting of a liquid crystal constituent which comes to mix in liquid crystal the coloring matter which has dichroism.

[Claim 8] A liquid crystal display given in any 1 term of claims 1-7 characterized by arranging the polarizing plate among the substrates of a top Norikazu pair at the non-contact side side with the liquid

crystal layer in one [at least] substrate.
[Claim 9] It has an electrical-potential-difference impression means to impress an electrical potential difference to the above-mentioned liquid crystal layer. This electrical-potential-difference impression means The phase contrast of the display light on the reflective means of the reflective display at the time of electrical-potential-difference impression The liquid crystal display according to claim 8 characterized by impressing an electrical potential difference so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of clear display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of clear display and a dark display.
[Claim 10] The liquid crystal display according to claim 8 or 9 with which the above-mentioned liquid crystal layer is characterized by carrying out twist orientation on the twist square of 60 degrees or more and 100 degrees or less between the substrates of the above-mentioned pair.
[Claim 11] The liquid crystal display according to claim 8 or 9 with which the above-mentioned liquid crystal layer is characterized by carrying out twist orientation on the twist square of 0 times or more and 40 degrees or less between the substrates of the above-mentioned pair.
[Claim 12] The above-mentioned liquid crystal display component is a liquid crystal display given in claims 1-6 which are at least one side among the above-mentioned reflective display and a transparency display, and are characterized by displaying by changing the orientation condition of a liquid crystal layer by rotating a liquid crystal molecule in parallel to a substrate, and any 1 term of 8 or 9.
[Claim 13] The above-mentioned liquid crystal display component is a liquid crystal display according to claim 12 characterized by equipping the above-mentioned liquid crystal layer with an electrical-potential-difference impression means to make the field inboard of a substrate produce electric field, among the above-mentioned reflective display and a transparency display corresponding to either.
[Claim 14] It is a liquid crystal display given in claims 1-9 characterized by one [at least] substrate equipping the field at least corresponding to one side with the orientation film which has a perpendicular stacking tendency among the above-mentioned reflective display in the contact surface with the above-mentioned liquid crystal layer, and a transparency display among the substrates of a top Norikazu pair, and any 1 term of 12 or 13.
[Claim 15] It is a liquid crystal display given in any 1 term of claims 1-14 to which one [at least] substrate equips the field corresponding to a reflective display with an insulator layer at least among the above-mentioned reflective display and a transparency display among the substrates of a top Norikazu pair, and it is characterized by forming this insulator layer so that the direction of the field corresponding to the above-mentioned reflective display in the thickness may become thicker than the field corresponding to a transparency display.
[Claim 16] To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area A liquid crystal display given in any 1 term of claims 1-15 characterized by arranging the color filter arranged on the field corresponding to the transparency display in the above-mentioned substrate, and the color filter which has the same lightness.
[Claim 17] To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area A liquid crystal display given in any 1 term of claims 1-15 characterized by arranging the color filter which has transparency color with lightness higher than the color filter arranged on the field corresponding to the transparency display in the above-mentioned substrate.

[Claim 18] A liquid crystal display given in any 1 term of claims 1-17 characterized by to set at least the area of the field which the color filter which has transparency color is arranged, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned color filter as the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair.
[Claim 19] A liquid crystal display given in any 1 term of claims 1-15 characterized by arranging the color filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair.
[Claim 20] The liquid crystal display according to claim 19 characterized by setting up the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of the transparency color of the above-mentioned color filter.
[Claim 21] To the field corresponding to a reflective display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair To a part of field [at least] corresponding to a transparency display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area A liquid crystal display given in any 1 term of claims 1-15 characterized by arranging the color filter arranged on the field corresponding to the reflective display in the above-mentioned substrate, and the color filter with which saturation has the transparency color more than an EQC.
[Claim 22] A liquid crystal display given in any 1 term of claims 1-21 to which it has the lighting system which carries out incidence of the light to the above-mentioned liquid crystal display component from the tooth back of this liquid crystal display component, and this lighting system is characterized by serving as a screen brightness modification means to change the brightness of the screen.
[Claim 23] The above-mentioned lighting system is a liquid crystal display according to claim 22 characterized by changing the brightness of the screen according to adaptation luminance so that consciousness lightness may be set to 10 or more brils and less than 30 brils.
[Claim 24] A liquid crystal display given in any 1 term of claims 1-23 characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by the screen.
[Claim 25] It is the liquid crystal display according to claim 22 or 23 characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by the screen, interlocking with [output signal / of the above-mentioned press coordinate detection blocking force means] the above-mentioned lighting system, and changing the brightness of the screen.
[Claim 26] It is the liquid crystal display according to claim 1 or 2 characterized by to provide a press coordinate detection blocking force means detect the coordinate location pressed when it was arranged in piles and pressed by the screen, to interlock with [output signal / of the above-mentioned press coordinate detection blocking force means] the above-mentioned orientation device, and to change the orientation condition of the liquid-crystal layer at least in one side among the above-mentioned reflective display and a transparency display.
[Claim 27] A liquid crystal display given in any 1 term of claims 1-26 characterized by providing the press coordinate detection blocking force means and polarizing plate which detect the coordinate location pressed when it was arranged in piles and pressed by the screen, and arranging the above-mentioned polarizing plate, the press coordinate detection blocking force means, and the liquid crystal display component at this order.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display used especially in more detail in the intense environment of change of the liquid crystal display with which the outdoors and indoor are used, an automobile, the aircraft, a vessel, etc. of a lighting environment about the liquid crystal display used for information machines and equipment, such as a word processor and a notebook sized personal computer, various visual equipments and a game device, the pocket mold VCR, a digital camera, etc.
[0002]
[Description of the Prior Art] Conventionally, the cathode-ray tube (CRT;Cathode Ray Tube), an electroluminescence (EL;ElectroLuminescence) component, a plasma display panel (PDP;Plasma DisplayPanel), etc. are electrically put in practical use as a spontaneous light type display which can rewrite the contents of a display.
[0003] However, in order for a spontaneous light type display to make the display light itself emit light and to use it for a display, it has the trouble that power consumption is large. Furthermore, since the luminescence side of a spontaneous light type display is the screen which has a high reflection factor in itself, when a spontaneous light type display is used, compared with luminescence brightness, the so-called washout phenomenon in which it becomes impossible to observe display light is not avoided in the situation, for example, direct-rays Shimo etc., that the ambient light of an operating environment is strong.
[0004] On the other hand, the liquid crystal display is given to practical use as a color display which displays an alphabetic character and an image by adjusting the amount of transmitted lights of the light from the specific light source, without the display light itself emitting light. This liquid crystal display (LCD;Liquid Crystal Display) can be divided roughly into a transparency mold liquid crystal display and a reflective mold liquid crystal display.
[0005] Among those, what is used current, especially widely as a color liquid crystal display is a transparency mold liquid crystal display using the light source called the so-called background lighting (back light) to a background, i.e., the tooth back of a liquid crystal cell. Although it had advantages, such as a thin shape and a light weight, and the application is expanded in various fields, it is one of these, this transparency mold liquid crystal display consumes a lot of power in order to make background lighting (back light) emit light, and although there is little power used for the permeability modulation of liquid crystal, it requires comparatively big power.
[0006] However, in such a transparency mold liquid crystal display (namely, transparency mold color liquid crystal display), the washout phenomenon looked at by said spontaneous light type display is reduced. This is because the reflection factor of the screen of the color filter layer by which the object for facilities is carried out to the transparency mold color liquid crystal display is reduced by the low reflection factor-ized technique of the color filter layer using a black matrix etc.
[0007] However, even if it is the case where a transparency mold color liquid crystal display is used, an ambient light is very strong, and when display light is weak, observation of display light becomes difficult relatively. For this reason, that such a trouble should be solved, if the background illumination light is

reinforced further, the problem of consuming more power will be invited.

[0008] Since a reflective mold liquid crystal display displays to the above luminescence mold displays or a transparency mold liquid crystal display using an ambient light, the display light proportional to the amount of ambient lights can be obtained. For this reason, a reflective mold liquid crystal display has the theoretic advantage of not causing the above-mentioned washout phenomenon, and can observe a display on the contrary more vividly in a very bright location where direct rays hit. furthermore, since a reflective mold liquid crystal display does not need background lighting (back light) in the display, it can reduce the power for making background lighting (back light) emit light -- etc. -- it has the advantage. For this reason, especially the reflective mold liquid crystal display fits use on the outdoors, such as a Personal Digital Assistant device, and a digital camera, a pocket video camera.

[0009] However, in the reflective mold liquid crystal display of these former, in order to use an ambient light for a display, the degree for which display brightness depends on a circumference environment is very high, and has the trouble that the contents of a display cannot be checked, under the weak environment of an ambient light. When the color filter used in order to realize a color display (color display) especially is used, in order that a color filter may absorb light, a display becomes dark further. Therefore, in such a case, the above-mentioned problem becomes much more remarkable.

[0010] Then, the lighting system called a front light is developed as supplemental lighting so that a reflective mold liquid crystal display can be used also under the weak environment of an ambient light. The reflecting plate is installed in the tooth back of a liquid crystal layer, and background lighting (back light) like a transparency mold liquid crystal display cannot be used for a reflective mold liquid crystal display. For this reason, the lighting system (front light) used for a reflective mold liquid crystal display illuminates a reflective mold liquid crystal display from a front, i.e., the screen, side.

[0011] It considers as the liquid crystal display with which the perimeter illumination light, on the other hand, enables use under a weak environment taking advantage of the advantage of a reflective mold liquid crystal display, a part of incident light is penetrated, and the liquid crystal display using the so-called semi-permeable reflective film made to reflect the remaining incident light is put in practical use. Thus, generally the liquid crystal display using both the transmitted light and the reflected light is called the transflective LCD.

[0012] For example, the transflective LCD which performs a lightness modulation to JP,59-218483,A (it corresponds to a Japanese-Patent-Application-No. No. 92885 [58 to] official report) using TN (Twisted Nematic) method and the liquid crystal display method which modulates transmitted light reinforcement, such as a STN (super twisted nematic) method, is indicated. Moreover, the transflective LCD with which the reflective film arranged by approaching a liquid crystal layer has semi-permeable is indicated by JP,7-318929,A. Furthermore, the transparency mold liquid crystal display using the in plane switching method as a technique of realizing a large angle of visibility is indicated by JP,6-160878,A.

[0013]

[Problem(s) to be Solved by the Invention] However, a transflective LCD given in JP,59-218483,A is a trouble (1) since the semi-permeable reflective film is arranged on the rear face of a liquid crystal cell, in view of the observer side, as shown below. And (2) It has.

[0014] That is, it is (1) first. Difficulty is followed on a setup of the lightness which influences the conspicuousness of a display. That is, to set up the lightness of a transflective LCD according to the lightness in the case of performing a reflective display, it is necessary to set up this lightness highly in preparation for use on conditions which run short of ambient lights. However, if the permeability of the polarizing plate used in TN method in order to make lightness high is set up highly, in a transparency display, the contrast ratios which ** and are defined by the lightness of a dark display of the lightness of clear display will run short, and visibility will be worsened. Although it is desirable to set up this lightness so that a contrast ratio may be raised on the other hand when setting up the above-mentioned lightness according to the lightness in the case of performing a transparency display, in a reflective display, lightness runs short in this case, and visibility is worsened.

[0015] Moreover, (2) In a reflective display, in order to reflect the light which passes the liquid crystal layer pinched by the substrate by the reflective film in which it was prepared at the rear face of a liquid crystal cell and to observe a display, the parallax (twin image) in a reflective display will be seen, the fall of resolution will be caused, and a high resolution display will be difficult.
[0016] Moreover, since the reflective film itself has semi-permeable, the transflective LCD given in said JP,7-318929,A has the trouble that the optical design suitable for a reflective display and a transparency display is impossible.
[0017] Furthermore, although the in plane switching method currently indicated in said JP,6-160878,A is used for the transparency mold liquid crystal display, the liquid crystal orientation on the Kushigata electrode does not contribute to a display. When this electrode wiring is many, since this is produced with a metal without translucency, it is because liquid crystal orientation change is inadequate for a transparency display.
[0018] Then, the invention-in-this-application person etc. tried to apply the means of displaying used for the reflective mold liquid crystal display which can control parallax to a transflective LCD that these technical problems should be solved. Specifically, it is (a). GH (guest host) method and (b) which arranged the liquid crystal constituent which mixed in the liquid crystal layer the coloring matter (dichroism coloring matter) which has dichroism It examined wholeheartedly using two methods of the reflective mold liquid crystal display method (it is hereafter written as an one-sheet polarizing plate method) using one polarizing plate for a transflective display.
[0019] In addition, the above (a) And (b) In order to arrange on the occasion of examination of use of the means of displaying which does not produce parallax as shown in two methods so that the reflective film may be ****(ed) in a liquid crystal layer, and to enable it to also use the transmitted light for a display in addition to the reflected light, the transparency opening part was prepared in the reflective film.
[0020] Consequently, the trouble of further the following became clear. First, (a) By GH method, if the concentration of the dichroism coloring matter mixed in a liquid crystal constituent is adjusted so that it may be suitable for a reflective display, in a transparency display, although lightness is high, it runs short of contrast ratios, and cannot obtain a good display. On the other hand, if the concentration of the above-mentioned dichroism coloring matter mixed in a liquid crystal constituent is adjusted so that it may be suitable for a transparency display, although a good contrast ratio is obtained, by the reflective display, lightness cannot fall and a good reflective display cannot be obtained at a transparency display.
[0021] Moreover, (b) A polarizing plate etc. is further added to the tooth back of whether when using an one-sheet polarizing plate method for a transflective display, a setup of the electrical potential difference impressed to the liquid crystal orientation and liquid crystal thickness which determine an optical property, or the liquid crystal which drives them is set up according to a reflective display, and the screen, a transparency display is performed (two-sheet polarizing plate method), and two kinds of whether to set up to compensate for this transparency display can be considered.
[0022] First, the display in the transparency display at the time of setting liquid crystal thickness as the thickness suitable for a reflective display is explained. Outside the electric field of the liquid crystal layer at the time of setting up the liquid crystal layer suitable for a reflective display etc., the amount of change of the polarization condition accompanying the orientation change by the place is extent from which it goes and comes back to a liquid crystal layer, and sufficient contrast ratio is obtained, when the front, i.e., the light which carried out incidence through the liquid crystal layer from the screen side, carries out outgoing radiation to a screen side through a liquid crystal layer again. However, in this setup, the transparency display of the variation of the polarization condition of the light which passed the liquid crystal layer is inadequate. For this reason, even if it installs the polarizing plate used only for a transparency display in the tooth back of a liquid crystal cell in addition to the polarizing plate installed in the observer, i.e., the screen, side of the liquid crystal cell used for a reflective display, in view of an observer side, display sufficient in a transparency display is not obtained. That is, when the orientation

conditions of a liquid crystal layer are set as the orientation conditions (liquid crystal thickness, liquid crystal orientation, etc.) of a liquid crystal layer of having been suitable for the reflective display, even if lightness runs short or a transparency display is enough as lightness, the permeability of a dark display does not fall and sufficient contrast ratio for a display is not obtained.
[0023] If it furthermore explains to a detail, when performing a reflective display, the orientation condition of the liquid crystal in the above-mentioned liquid crystal layer is controlled by the electrical potential difference impressed to the above-mentioned liquid crystal layer so that the phase contrast of quarter-wave length is given in general to the light which passes a liquid crystal layer only at once. If only the electrical-potential-difference modulation which gives the phase modulation of quarter-wave length to the light which passes a liquid crystal layer is performed using the liquid crystal layer set up that such phase contrast should be given to the light which passes a liquid crystal layer and a transparency display is performed When fully reducing permeability in case a transparency display is a dark display, when a transparency display is clear display, the light of the reinforcement of abbreviation one half is absorbed with the polarizing plate by the side of the outgoing radiation of light, and sufficient clear display is not obtained. Moreover, since lightness in case a transparency display is clear display is increased, if optical elements, such as a polarizing plate and a phase contrast compensating plate, are arranged, lightness in case a transparency display is a dark display will turn into lightness of the abbreviation 1/2 of the lightness at the time of clear display, and will become inadequate [the contrast ratio of a display].
[0024] Next, the display in the reflective display at the time of setting the orientation conditions of a liquid crystal layer as the conditions suitable for a transparency display is explained. When performing a reflective display in the liquid crystal layer suitable for a transparency display, the polarization condition of the light which passes a liquid crystal layer only at once needs to control liquid crystal orientation by the electrical-potential-difference modulation to become irregular between two polarization conditions which intersect perpendicularly mostly. Here, two polarization conditions which intersect perpendicularly may be the two linearly polarized lights which have the plane of vibration which intersects perpendicularly, and you may be the circular polarization of light on either side, and major-axis bearing may intersect perpendicularly by two elliptically polarized light of the still more nearly same ovality, and the hand of cut of a photoelectrical community may be reversed. In order to realize the modulation of the polarization condition between the combination of these two polarization conditions that intersect perpendicularly, it is necessary to carry out an electrical-potential-difference modulation so that 1/2 wave of phase contrast may be given to the transmitted light in a liquid crystal layer. Thus, in any case, when the polarization condition of light becomes irregular between two polarization conditions which intersect perpendicularly, an operation of a polarizing plate and an operation of the phase contrast compensating plate used if needed can realize sufficient lightness and a sufficient contrast ratio in a transparency display.
[0025] When the above-mentioned liquid crystal layer is set up that such control should be realized, however, in a transparency display While changing from clear display to a dark display only at once, it sets to a reflective display. When the orientation change means of liquid crystal is the same, the display of the same light and darkness cannot be realized -- fluctuation of a reflection factor becomes a dark display from clear display, and becomes clear display further -- (for example, when the thickness of a liquid crystal layer is the same and also drives initial orientation on the same and still more nearly same electrical potential difference). In addition, the above (a) - (b) The technical problem produced in a case is the same as that of said JP,7-318929,A also in the transflective LCD of a publication.
[0026] Moreover, since itself has the reflexibility over light, the press sensing input device (touch panel) used for a liquid crystal display in piles has the trouble of being easy to worsen visibility, and the inclination is remarkable in especially a reflective mold liquid crystal display.
[0027] Moreover, many are plane light pipe structure, and since the contents of a display are observed over this light pipe, the front light unit to which an ambient light improves the visibility of the reflective

mold liquid crystal display in a dark environment has ****, while saying that visibility tends to get worse.
[0028] This invention is made in view of the above-mentioned trouble, and the purpose is excellent in visibility, and a high resolution display is possible, and it is in offering the liquid crystal display which can use both the reflected light and the transmitted light for a display. Moreover, the further purpose of this invention is excellent in visibility, and high resolution color display is possible for it, and it is to offer the liquid crystal display which can use both the reflected light and the transmitted light for a display.
[0029]
[Means for Solving the Problem] The cause of the trouble of the above-mentioned conventional liquid crystal display finds out the conclusion that it is because the orientation of the liquid crystal layer in this time of day is similarly set up by the transparency display and the reflective display in any [of the above-mentioned GH method and a polarizing plate method] case, and the invention-in-this-application person etc. came to complete this invention, as a result of inquiring wholeheartedly that the above-mentioned purpose should be attained.
[0030] Here, the orientation of a liquid crystal layer shall show not only orientation bearing of an average of the liquid crystal molecule in a point with a liquid crystal layer but the coordinate dependency of average orientation bearing to the coordinate taken in the direction of a normal of the layer of a layer-like liquid crystal layer.
[0031] Namely, the liquid crystal display according to claim 1 by this invention The substrate of a pair with which the orientation means (for example, orientation film) was given to the front face which counters in order to solve the above-mentioned technical problem, It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrates of this pair. the orientation device (for example, the electrode which produces electric field which are arbitrary, give an electrical potential difference which is different to a different field used for the display in the above-mentioned liquid crystal layer, or are different --) for making coincidence take at least two kinds of different orientation conditions to a field which is used for the display in the above-mentioned liquid crystal layer and which is arbitrary and is different The orientation film by which was arbitrary, and was respectively prepared in a different field used for the display in the impressed electrical potential difference or the above-mentioned liquid crystal layer, and orientation processing was carried out in at least two kinds of the different bearings, Or the insulator layer and substrate which were formed so that it might have at least two kinds of different thickness in the field used for the display in the above-mentioned liquid crystal layer, A specific liquid crystal ingredient, the liquid crystal layer structure formed so that it might drive respectively independently, A polarizing plate, phase contrast compensating plates, or those combination are provided. A reflective means (for example, the reflective film and a reflector) is allotted to at least one field among the fields which show a different orientation condition in the above-mentioned liquid crystal layer. The account of a top And the reflective display to which the field which shows a different orientation condition performs a reflective display, It is characterized by being used for the transparency display which performs a transparency display.
[0032] According to the above-mentioned configuration, by having the orientation condition that liquid crystal orientation differs in coincidence, in using coloring matter, such as dichroism coloring matter, for a display and using the amount of absorption of light (absorption coefficient), and an optical anisotropy, it becomes possible to change the magnitude of the amount of modulations of each optical physical quantity called phase contrast for every field where liquid crystal orientation differs. For this reason, according to the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity according to the orientation condition of a liquid crystal layer can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned configuration, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be

acquired even when an ambient light is strong. For this reason, according to the above-mentioned configuration, it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.

[0033] Furthermore, the liquid crystal display according to claim 2 concerning this invention is characterized by the above-mentioned orientation device being the contents rewriting means of a display which rewrites the contents of a display in connection with the passage of time in the liquid crystal display according to claim 1, in order to solve the above-mentioned technical problem.

[0034] The liquid crystal display of the claim 1 above-mentioned publication can be obtained without according to the above-mentioned configuration, the same means' being able to realize the contents rewriting means of a display, and the above-mentioned orientation device, and adding a new configuration. In this case, a possible thing cannot be overemphasized even if it is the various means used for electrical-potential-difference impression of the electric liquid crystal orientation control means used widely now, i.e., an electrode etc., in order to rewrite the contents of a display in connection with the passage of time as the above-mentioned contents rewriting means of a display used in order to take two or more conditions that liquid crystal orientation differed. Two or more fields which have the orientation condition that liquid crystal orientation differs can be prepared in a liquid crystal layer by using an electrode which is different by the transparency display and the reflective display in this case, or changing the electrical potential difference itself by the transparency display and the reflective display.

[0035] Moreover, when extent of the amount of modulations of each optical physical quantity, such as the amount of absorption of light and phase contrast by the optical anisotropy, is independently changed by the reflective display and the transparency display, Even when the direction of orientation of the liquid crystal by impression of an electrical potential difference is almost the same in the whole field for using for the display of a liquid crystal layer, in the field in which the liquid crystal thickness of a liquid crystal layer differs, it has substantially the same operation as the case where the direction of orientation of a liquid crystal layer is changed in this field. Coloring matter, such as dichroism coloring matter, is used especially, in the polarizing plate method using GH method using the absorption of light, a birefringence, or a rotatory-polarization phenomenon, each of each phenomena of the absorption of light produced in a liquid crystal layer and a birefringence is phenomena accompanying propagation of light, and each phenomenon has relevance between the propagation distance of the light in a liquid crystal layer, and extent of those phenomena. Furthermore, display light passes a liquid crystal layer twice by round trip in a reflective display, in order to pass a liquid crystal layer only at once in a transparency display, when liquid crystal orientation is almost the same and liquid crystal thickness is similarly set up by the reflective display and the transparency display, sufficient lightness or a sufficient contrast ratio are not obtained and said technical problem is not solved.

[0036] Then, the liquid crystal display according to claim 3 concerning this invention The substrate of a pair with which the orientation means (for example, orientation film) was given to the front face which counters in order to solve the above-mentioned technical problem, It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrates of this pair. While each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display A reflective means (for example, the reflective film and a reflector) is allotted to a reflective display at least, and liquid crystal thickness of the above-mentioned reflective display is characterized by being smaller than a transparency display.

[0037] According to the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible [setting up an optical parameter

independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned configuration, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired even when an ambient light is strong. For this reason, according to the above-mentioned configuration, it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.

[0038] The liquid crystal display according to claim 4 concerning this invention In a liquid crystal display given in any 1 term of claims 1-3 in order to solve the above-mentioned technical problem It is characterized by giving the orientation means so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of a top Norikazu pair in the orientation of the liquid crystal layer interface which touches it.

[0039] Thus, it is given to the interface on the substrate which touches for example, the above-mentioned liquid crystal layer in addition to the contents rewriting means of a display shown, for example in above-mentioned claim 2 as a means for having the orientation condition that liquid crystal orientation differs in coincidence, and the orientation film by which orientation processing was carried out so that at least two kinds of different directions of orientation might be given to the orientation of the liquid crystal layer interface which touches it can be used. By thus, the thing performed for the orientation means so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in the above-mentioned substrate front face in the orientation of the liquid crystal layer interface which touches it In the field to which the above-mentioned liquid crystal layer is the arbitration for using for the display in this liquid crystal layer, and differ at the time of electrical-potential-difference impression, at least two kinds of different orientation conditions can be shown in coincidence, and a reflective display and a transparency display can be performed in the field in which the orientation conditions in the above-mentioned liquid crystal layer differ.

[0040] In this case, both the orientation of the liquid crystal which determines an optical property, and the orientation change at the time of impressing an electrical potential difference can be changed by changing the elevation angle over the substrate of liquid crystal orientation, and its azimuth, and it becomes possible to perform the display which was suitable for each display by the reflective display and the transparency display.

[0041] According to this invention, according to the means and orientation device which were mentioned above, although a good display is realizable by both the reflective display and the transparency display The optimal ratio for performing a good display into the ratio of a reflective display and a transparency display exists by the displays for which it asks, such as whether a color display (color display) is performed or monochrome display is performed, it displays by indicating it a subject by reflective, or to display by indicating it a subject by transparency.

[0042] That is, in order that the liquid crystal display according to claim 5 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display given in any 1 term of claims 1-4, the rate that the area of the reflective display to the area of the sum total of the above-mentioned reflective display and a transparency display occupies is characterized by being 30% or more and 90% or less.

[0043] Moreover, it is desirable for the contents of a display not to be reversed by the reflective display from a viewpoint and transparency display of visibility. It is for the contrast ratio of a display with the reinforcement of an ambient light being large, and changing this, if a lighting environment changes or the contents of a display are reversed by the reflective display and the transparency display in a situation with difficult prediction of change of a lighting environment, and fluctuation of such a contrast ratio serves as the same phenomenon as a washout, and causes large aggravation of visibility from the point of visibility.

[0044] Then, it is very important that a reflective display displays clear display on coincidence when a transparency display is clear display, and a reflective display displays a dark display on coincidence when a transparency display is a dark display, when securing visibility.
[0045] For this reason, the liquid crystal display according to claim 6 concerning this invention is characterized by for a reflective display serving as clear display at coincidence, when the above-mentioned transparency display is clear display, and a reflective display serving as a dark display at coincidence, when the above-mentioned transparency display is a dark display in the liquid crystal display given in any 1 term of claims 1-5, in order to solve the above-mentioned technical problem.
[0046] Moreover, in order that the liquid crystal display according to claim 7 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display given in any 1 term of claims 1-6, the above-mentioned liquid crystal layer is characterized by consisting of a liquid crystal constituent which comes to mix the coloring matter which has dichroism at liquid crystal.
[0047] According to the above-mentioned configuration, when the above-mentioned liquid crystal layer consists of a liquid crystal constituent which comes to mix in liquid crystal the coloring matter which has dichroism, the amount of absorption of light can be rationalized by the reflective display and the transparency display.
[0048] Moreover, it is also effective to use the method which uses a birefringence and a rotatory-polarization phenomenon for a display by both the reflective display and the transparency display, using a polarizing plate as means of displaying for performing a good display.
[0049] For this reason, the liquid crystal display according to claim 8 concerning this invention is characterized by arranging the polarizing plate among the substrates of the above-mentioned pair at the non-contact side side with the liquid crystal layer in one [at least] substrate in the liquid crystal display given in any 1 term of claims 1-7, in order to solve the above-mentioned technical problem.
[0050] According to the above-mentioned configuration, by the reflective display and the transparency display, a birefringence can be rationalized and a good display can be performed. In order to use a polarizing plate method for a reflective display and to secure sufficient display in a transparency display with the liquid crystal display of the claim 3 above-mentioned publication at this time, it is required not only for a screen side but the incidence side of the light of a transparency display to have a polarizing plate.
[0051] Moreover, in a reflective display, as for the variation of the phase contrast of the light from which the orientation change by the electrical potential difference of a liquid crystal layer is also hung down in the liquid crystal display of the claim 8 above-mentioned publication, it is desirable to set up so that it may be suitable for the light which goes and comes back to a liquid crystal layer, and to set up so that it may be suitable for the light which penetrates a liquid crystal layer in a transparency display, when changing a display.
[0052] For this reason, the liquid crystal display according to claim 9 concerning this invention In order to solve the above-mentioned technical problem, in a liquid crystal display according to claim 8, it has an electrical-potential-difference impression means (for example, electrode) to impress an electrical potential difference to the above-mentioned liquid crystal layer. This electrical-potential-difference impression means The phase contrast of the display light on the reflective means of the reflective display at the time of electrical-potential-difference impression It is characterized by impressing an electrical potential difference so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of clear display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of clear display and a dark display.
[0053] In this case, as are shown in claim 10, and the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of the above-mentioned pair on the twist square of 60 degrees or more and 100 degrees or less or it is shown in claim 11, as for the liquid crystal orientation in the above-mentioned liquid crystal layer, specifically, it is desirable that the above-mentioned liquid

crystal layer is carrying out twist orientation between the substrates of the above-mentioned pair on the twist square of 0 times or more and 40 degrees or less.

[0054] The above-mentioned liquid-crystal layer can use change of the polarization near the rotatory polarization according to a twist of the orientation of liquid crystal for a display in the liquid-crystal layer of a transparency display with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 60 degrees or more and 100 degrees or less, and it can use change of the polarization by control with the rotatory polarization and a retardation for a display in a reflective display between the substrates of the above-mentioned pair.

[0055] Moreover, the above-mentioned liquid crystal layer can use both change of a retardation for a display also in the liquid crystal layer of a reflective display also in the liquid crystal layer of a transparency display between the substrates of the above-mentioned pair with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 0 times or more and 40 degrees or less.

[0056] Moreover, in a liquid crystal display given in above-mentioned claims 1-6 and any 1 term of 8 or 9, even if orientation change of liquid crystal is only modification of bearing in a field parallel to a substrate, sufficient display is possible for it.

[0057] Namely, the liquid crystal display according to claim 12 concerning this invention In a liquid crystal display given in claims 1-6 and any 1 term of 8 or 9 in order to solve the above-mentioned technical problem the above-mentioned liquid crystal display component It is characterized by displaying by changing the orientation condition of a liquid crystal layer among the above-mentioned reflective display and the transparency display by rotating a liquid crystal molecule in parallel to a substrate at least by one side.

[0058] Furthermore, in this invention, the lowness of the efficiency for light utilization of an in plane switching method is conquerable by using positively for a display the insufficiency of the liquid crystal orientation leading to the low light transmittance which is the technical problem of the conventional in plane switching method as a reflective display.

[0059] That is, in order that the liquid crystal display according to claim 13 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display according to claim 12, the above-mentioned liquid crystal display component is characterized by equipping the above-mentioned liquid crystal layer with an electrical-potential-difference impression means to produce electric field in the field inboard of a substrate, among the above-mentioned reflective display and a transparency display corresponding to either.

[0060] Moreover, although the orientation of a liquid crystal layer may be parallel orientation that to a display used, it may be perpendicular orientation as for which liquid crystal is carrying out orientation perpendicularly to the substrate. [than before] [more]

[0061] The liquid crystal display according to claim 14 concerning this invention In a liquid crystal display given in claims 1-9 and any 1 term of 12 or 13 in order to solve the above-mentioned technical problem one [at least] substrate among the substrates of the above-mentioned pair It is characterized by equipping the field at least corresponding to one side with the orientation film which has a perpendicular stacking tendency among the above-mentioned reflective display in the contact surface with the above-mentioned liquid crystal layer, and a transparency display.

[0062] Thus, the above-mentioned substrate is equipped with the orientation film which has a perpendicular stacking tendency, and there is an advantage to which the contrast ratio of a display becomes good in being the perpendicular orientation as for which liquid crystal is carrying out orientation perpendicularly to the substrate, and moreover, when performing a good display to above-mentioned claims 1-9, and 12 or 13 in the liquid crystal display of a publication, it acts effectively.

[0063] Moreover, the liquid crystal display according to claim 15 concerning this invention In a liquid crystal display given in any 1 term of claims 1-14 in order to solve the above-mentioned technical problem One [at least] substrate equips the field corresponding to a reflective display with an insulator

layer at least among the above-mentioned reflective display and a transparency display among the substrates of a top Norikazu pair. This insulator layer The thickness is characterized by being formed so that the direction of the field corresponding to the above-mentioned reflective display may become thicker than the field corresponding to a transparency display.
[0064] That is, the above-mentioned liquid crystal display has an insulator layer on one [which pinches a liquid crystal layer / at least] almost smooth substrate, this insulator layer is a field corresponding to a transparency display, it is formed so that thickness may become thin rather than the field corresponding to a reflective display, or the insulating layer is formed only in the field corresponding to a reflective display, and the insulator layer is not formed in the field corresponding to a transparency display.
[0065] According to the above-mentioned configuration, the field used for the display in a liquid crystal layer can obtain easily the liquid crystal display (namely, liquid crystal display with which liquid crystal thickness differs by the reflective display and the transparency display) which has at least two kinds of different liquid crystal thickness.
[0066] Moreover, the above-mentioned insulator layer can be impressed to a liquid crystal layer without loss of the electrical potential difference which drives a liquid crystal layer by forming the electrode for a display in the field where it not only acts as an adjustment means of liquid crystal thickness, but the above-mentioned insulator layer touches a liquid crystal layer in a reflective display.
[0067] In this case, the film which has light reflex nature as a reflective means in the substrate by the side of the screen and the substrate by which opposite arrangement was carried out is formed. It is effective that the film which has this light reflex nature has concavo-convex structure as a mirror plane nature prevention means of the reflective display which does not spoil resolution, without spoiling the display engine performance of a transparency display. The above-mentioned insulator layer can form easily the film which has the above-mentioned light reflex nature which has concavo-convex structure by having the membranous concavo-convex structure of having the above-mentioned light reflex nature, and the same concavo-convex structure.
[0068] Moreover, when performing color display using the liquid crystal display of this invention, the design of not only a liquid crystal layer but a color filter layer important for coloring is important. According to examination of invention-in-this-application persons, there are two kinds of main use gestalten of a transflective type liquid crystal display.
[0069] By one usually mainly using a transparency display in use, and using a reflective display additionally Prevent the washout under the very strong lighting environment of an ambient light, and it compares with a luminescence mold display or the liquid crystal display of only a transparency display. It is the use gestalt which secures the large versatility of an usable lighting environment and which indicates it a subject by transparency. Another usually, in use, under the weak environment of lighting taking advantage of the property of reflective display that there is little power consumption By turning on and using the lighting system called the so-called back light, it is the use gestalt which secures the large versatility of an usable environment like a previous use gestalt and which indicates it a subject by reflective.
[0070] In a previous use gestalt (use gestalt which indicates it a subject by transparency), among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned pair, at least, it excels in visibility by arranging the color filter which has transparency color to the field corresponding to a transparency display, and high resolution color display is possible and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0071] And especially the thing for which the color filter which has transparency color is arranged on a transparency display at least, and the color filter which arranges the color filter arranged on the transparency display and the color filter which has the same lightness on a part of reflective display [at least] at a reflective display, not using a color filter, or has the high transparency color of lightness

rather than it is arranged on each pixel when performing color display in this way is effective.
[0072] If the color filter of a transparency display is used for a reflective display as it is, when it will be because lightness runs short and a reflective display will also perform color display, this By arranging the color filter which establishes the field which does not use a color filter in a reflective display, or has the high transparency color of lightness rather than a transparency display in a reflective display It is because lightness is suppliable, color display becomes possible and a reflection factor required for a reflective display can be secured also to a reflective display.
[0073] And in a reflective display, if it takes into consideration that display light passes a color filter twice, it is desirable to arrange the color filter which has the high transparency color of lightness rather than a transparency display on a reflective display.
[0074] Moreover, in the use gestalt which indicates it a subject by transparency, when considering as the configuration which has the field which does not prepare a color filter in a reflective display, a display voltage signal required for a transparency display is the signal for which it was suitable to the color display, and a display voltage signal required for a reflective display is the signal it was suitable to monochrome display in the example which is not used at all in a color filter to a reflective display. Therefore, although the rate which the pixel of each color contributes to lightness when considering as the configuration which does not prepare a color filter in a reflective display is proportional to the luminous transmittance of each color in a transparency display, since it becomes equal, when considering as the configuration which does not prepare a color filter in a reflective display, with a reflective display, it is desirable [it is each color and] in changing the area of the field which does not perform in the color display of a reflective display according to the luminous transmittance of each color of the color filter used for a transparency display.
[0075] Namely, the liquid crystal display according to claim 16 concerning this invention In a liquid crystal display given in any 1 term of claims 1-15 in order to solve the above-mentioned technical problem To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area It is characterized by arranging the color filter arranged on the field corresponding to the transparency display in the above-mentioned substrate, and the color filter which has the same lightness.
[0076] Moreover, the liquid crystal display according to claim 17 concerning this invention In a liquid crystal display given in any 1 term of claims 1-15 in order to solve the above-mentioned technical problem To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area It is characterized by arranging the color filter which has transparency color with lightness higher than the color filter arranged on the field corresponding to the transparency display in the above-mentioned substrate.
[0077] Furthermore, the liquid crystal display according to claim 18 concerning this invention In a liquid crystal display given in any 1 term of claims 1-17 in order to solve the above-mentioned technical problem The inside of the field which constitutes the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair, It is characterized by setting at least the area of the field which the color filter which has transparency color is arranged, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned color filter as the field corresponding to a transparency display.
[0078] Moreover, it sets in the second use gestalt (use gestalt which indicates it a subject by reflective). By arranging the color filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair It excels in visibility, and high resolution color display is possible,

and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0079] And especially the thing for which the color filter which arranges at least the color filter which has transparency color on a reflective display, and performs a color display to each pixel, has the same saturation as the color filter arranged on the reflective display at a part of transparency display [at least] in a transparency display, not using a color filter, or has the high transparency color of saturation rather than it is arranged when performing color display in this way is effective.
[0080] In the use gestalt which indicates it a subject by reflective, in a transparency display, when monochrome display is performed not using a color filter, since the permeability of light rises, it is possible to set up a transparency display still smaller. Thereby, the area of a reflective display can be secured more greatly and a better display can usually be obtained in the reflective display at the time of use.
[0081] Moreover, in the use gestalt which indicates it a subject by reflective, the contribution to the lightness of monochrome display of the transparency display in each pixel can be set up proper in consideration of luminous transmittance by changing the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of each color of the color filter used for a reflective display.
[0082] That is, the liquid crystal display according to claim 19 concerning this invention is characterized by arranging the color filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned pair in the liquid crystal display given in any 1 term of claims 1-15, in order to solve the above-mentioned technical problem.
[0083] Moreover, the liquid crystal display according to claim 20 concerning this invention is characterized by setting up the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of the transparency color of the above-mentioned color filter in the liquid crystal display according to claim 19, in order to solve the above-mentioned technical problem.
[0084] Furthermore, the liquid crystal display according to claim 21 concerning this invention In a liquid crystal display given in any 1 term of claims 1-15 in order to solve the above-mentioned technical problem To the field corresponding to a reflective display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a top Norikazu pair To a part of field [at least] corresponding to a transparency display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area It is characterized by arranging the color filter arranged on the field corresponding to the reflective display in the above-mentioned substrate, and the color filter with which saturation has the transparency color more than an EQC.
[0085] Moreover, since the above-mentioned liquid crystal display concerning this invention is equipped with the reflective display as mentioned above, it doubles and has the description of the low power in the conventional reflective mold liquid crystal display. However, continuing maintaining this at a lighting condition causes increase of power consumption using the big illumination light of power consumption.
[0086] Then, in order that the liquid crystal display according to claim 22 concerning this invention may solve the above-mentioned technical problem, it has the lighting system which carries out incidence of the light to any 1 term of claims 1-21 from the tooth back of this liquid crystal display component in the liquid crystal display of a publication at the above-mentioned liquid crystal display component, and is characterized by this lighting system serving as a screen brightness modification means to change the brightness of the screen.
[0087] According to the above-mentioned configuration, coexistence with a low power and visibility can be aimed at by changing the brightness of the screen with a lighting system.
[0088] Furthermore, in order that the liquid crystal display according to claim 23 concerning this

invention may solve the above-mentioned technical problem, in the liquid crystal display according to claim 22, the above-mentioned lighting system is characterized by changing the brightness of the screen according to adaptation luminance, so that consciousness lightness may be set to 10 or more brils and less than 30 brils.

[0089] The above-mentioned consciousness lightness is prescribed by adaptation luminance and the brightness of the screen. At this time, it is very desirable to change the brightness of the screen so that the above-mentioned consciousness lightness may be acquired by changing the reinforcement of lighting, putting out lights, or lighting according to the adaptation luminance from which the above-mentioned lighting system changes with the contents of a display of a liquid crystal display and the visual environment of lighting etc., when aiming at coexistence with a low power and visibility. When the above-mentioned lighting system is especially controlled by press coordinate detection blocking force means, such as a touch panel, etc. from the liquid crystal display component outside, the above-mentioned effectiveness will become much more remarkable.

[0090] Moreover, low-power-ization can be attained, while according to the above-mentioned configuration being able to improve the visibility in the situation which the transparency display has mainly contributed to the display and being able to realize good visibility.

[0091] Moreover, in the transflective type liquid crystal display concerning this invention, as compared with the reflective mold liquid crystal display using the so-called front light, use of press coordinate detection blocking force means, such as a touch panel, is easy, and there is a big advantage at this point. Therefore, it is effective to realize the display good at a transflective type using such a press coordinate detection blocking force means because of the small liquid crystal display of the power consumption of good input unit one apparatus.

[0092] That is, the liquid crystal display according to claim 24 concerning this invention is characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by any 1 term of claims 1-23 in the liquid crystal display of a publication at the screen, in order to solve the above-mentioned technical problem.

[0093] Furthermore, since it is compatible in reduction of power consumption, and good visibility, it is effective to change the brightness of the lighting system which influences the power consumption of a liquid crystal display according to this signal, and to change the brightness of the screen, since it is easily detected that the observer is using the display with the signal of this press coordinate detection blocking force means when such a press coordinate detection blocking force means is used, or to change liquid crystal orientation.

[0094] Then, the liquid crystal display according to claim 25 concerning this invention In order to solve the above-mentioned technical problem, it sets to a liquid crystal display according to claim 22 or 23. It is characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by the screen, interlocking with [output signal / of the above-mentioned press coordinate detection blocking force means] the above-mentioned lighting system, and changing the brightness of the screen.

[0095] Moreover, the liquid crystal display according to claim 26 concerning this invention In order to solve the above-mentioned technical problem, it sets to a liquid crystal display according to claim 1 or 2. A press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by the screen is provided. The above-mentioned orientation device It is characterized by for the output signal of the above-mentioned press coordinate detection blocking force means being interlocked with, and changing the orientation condition of the liquid crystal layer at least in one side among the above-mentioned reflective display and a transparency display.

[0096] Moreover, when the above-mentioned liquid crystal display concerning this invention is equipped with both the above-mentioned press coordinate detection blocking force means and a polarizing plate, the above-mentioned press coordinate detection blocking force means and a polarizing plate are arranged in order of a polarizing plate, a press coordinate detection blocking force means, and a liquid

crystal display component.
[0097] Namely, the liquid crystal display according to claim 27 concerning this invention In a liquid crystal display given in any 1 term of claims 1-26 in order to solve the above-mentioned technical problem The press coordinate detection blocking force means and polarizing plate which detect the coordinate location pressed when it was arranged in piles and pressed by the screen are provided, and it is characterized by arranging the above-mentioned polarizing plate, the press coordinate detection blocking force means, and the liquid crystal display component at this order.
[0098] By arranging the above-mentioned polarizing plate, a press coordinate detection blocking force means, and a liquid crystal display component in this way, absorption by the polarizing plate can also absorb the unnecessary reflected light by the press coordinate detection blocking force means, and can reduce this unnecessary reflected light. Therefore, according to the above-mentioned configuration, the visibility of the liquid crystal display concerning this invention can be improved.
[0099]
[Embodiment of the Invention] The liquid crystal display by this invention is characterized by the ability of the liquid crystal orientation of a reflective display, and the liquid crystal orientation of a transparency display to take the condition of differing at this time of day. Here, liquid crystal orientation shall show not only average orientation bearing of the liquid crystal molecule in a point with a liquid crystal layer but the coordinate dependency of average orientation bearing to the coordinate taken in the direction of a normal of the layer of a layer-like liquid crystal layer. So, this invention classifies and explains greatly the orientation device in which it is used for this approach at the approach list which realizes liquid crystal orientation which is different by the reflective display and the transparency display to three kinds.
[0100] The 1st approach is an approach of changing the liquid crystal orientation of a reflective display, and the liquid crystal orientation of a transparency display, by using the orientation device produced so that conditions with a liquid crystal layer might differ by the transparency display and the reflective display.
[0101] Specifically as the 1st approach of the above, it is (1). The approach and (2) using the orientation device which carries out twist orientation so that it may have the twist angle from which liquid crystal orientation completely differs by the transparency display and the reflective display The approach using the orientation device in which the tilt angle to the substrate of liquid crystal orientation is made to change greatly etc. is mentioned. Moreover, in the 1st approach of the above, it is (3). The approach of arranging a liquid crystal ingredient which is different by the transparency display and the reflective display, (4) How (by the transparency display and the reflective display in this case) to change a transparency display and a reflective display in the class and concentration of the coloring matter mixed in liquid crystal ingredient The liquid crystal display which it is included that the same liquid crystal ingredient may be used etc. and applied to this invention possesses the device made when realizing such an approach as an orientation device of this invention. Moreover, the orientation devices in which it is used for this approach at the approach list of the above 1st are these (1). - (4) An approach may be combined and the orientation device in which it is used for this approach at these approach lists can realize liquid crystal orientation which is different by the reflective display and the transparency display.
[0102] The 2nd approach is an approach (namely, the approach as the contents rewriting means of a display that the orientation device in which liquid crystal orientation is changed by the transparency display and the reflective display is the same) of changing liquid crystal orientation by the transparency display and the reflective display with the contents rewriting means of a display which rewrites the contents of a display in connection with the passage of time. The existing rewriting means of a display can be used as a contents rewriting means of a display used when adopting this approach.
[0103] Specifically as the 2nd approach of the above, it is (5). The approach of changing the approach (i.e., the electrical potential difference itself used as a contents rewriting means of a display) of rewriting liquid crystal orientation by the transparency display and the reflective display by using an electrode

which is different by the transparency display and the reflective display as an orientation device etc. is employable. Moreover, it is (6) as the 2nd approach of the above. Although the electrode is the same, the approach of changing the electrical potential difference substantially impressed to liquid crystal orientation may be used. Above (6) When adopting an approach, the liquid crystal orientation of a transparency display and the liquid crystal orientation of a reflective display which are driven with a common electrode may be changed by arranging the insulator (for example, insulator layer) of thickness which is different by the reflective display and the transparency display between a liquid crystal layer and the electrode which drives it. Moreover, (7) The approach of changing the direction of electric field by the transparency display and the reflective display may be used. For example, it is arranged in parallel with one side of the substrate which pinches a liquid crystal layer, and when displaying on a liquid crystal layer by the electrode group which gives respectively different potential by changing the direction of liquid crystal orientation within a liquid crystal stratification plane, since liquid crystal orientation differs greatly, the field where these liquid crystal orientation differs may be respectively used for a reflective display and a transparency display inter-electrode and on an electrode. Furthermore, the approach of giving respectively different potential to the liquid crystal layer which carried out orientation perpendicularly to the substrate by the same electrode group may be adopted. When adopting the 2nd approach of the above, an electrode, insulators, or such combination are equivalent to the orientation device of this invention, and the obtained liquid crystal display which was used when realizing the above-mentioned approach has become a thing possessing these orientation devices, for example.

[0104] The 3rd approach is the approach of changing the thickness of the liquid-crystal layer which is the element which determines an optical property although the liquid-crystal orientation itself is not greatly different by the reflective display and the transparency display, and the insulator layer formed in thickness which is different by for example, the reflective display and the transparency display, the substrate which were formed in the thickness or the configuration in which a reflective display differs from a transparency display are used for implementation of this approach as the above-mentioned orientation device.

[0105] When adopting the 3rd approach of the above, the liquid crystal orientation twisted uniformly may be used for liquid crystal orientation like TN method used with the liquid crystal display which uses two polarizing plates. In this case, orientation of the liquid crystal orientation is carried out in parallel to a substrate between the substrates which pinch a liquid crystal layer, and twist orientation of that direction of orientation is carried out, changing a direction in a substrate flat surface according to the distance from one substrate. If this liquid crystal orientation is changed and liquid crystal thickness is used for a reflective display and a transparency display for it, since an optical property changes with liquid crystal thickness, a good display is realizable by both the reflective display and the transparency display.

[0106] Moreover, also in GH method, since there is the same effectiveness as the case where coloring matter concentration is substantially changed by change of liquid crystal thickness, even if the liquid crystal orientation itself is almost the same at a reflective display and a transparency display, it can realize a good display to each of a reflective display and a transparency display.

[0107] As mentioned above, although the orientation device in_which it is used for this approach at the approach list which realizes liquid crystal orientation which is different by the reflective display and the transparency display is roughly classified into three kinds, the liquid crystal display method used in the liquid crystal display concerning this invention realized according to these approaches and orientation devices is not limited especially that what is necessary is just to choose orientation change of liquid crystal from the method group used for a display suitably. Specifically as the above-mentioned liquid crystal display method used in this invention, various modes, such as for example, TN method which is the mode in which the nematic phase of a liquid crystal constituent is used for a display, a STN method, pneumatic bistability mode, perpendicular orientation mode, hybrid orientation mode, and ECB

(electrically controlled biriefringence; electric-field control birefringence) mode, can be used. Moreover, it can use as the above-mentioned liquid crystal display method with which for example, the polymer dispersed liquid crystal mode which is the mode in which dispersion is used, a dynamic scattering method, etc. are used in this invention. Furthermore, it is available as the above-mentioned liquid crystal display method with which the surface passivation strong dielectric liquid crystal display method using a ferroelectric liquid crystal constituent and the non-threshold switching antiferroelectric liquid crystal display method which used antiferroelectricity liquid crystal are also used in this invention in order to use orientation change for a display.

[0108] Moreover, when adopting the 3rd approach of the above, the above-mentioned liquid crystal display method used in this invention may be a method using the modulation of optical activity like TN method, may be a method using the modulation of a retardation like ECB mode, and may be a method with which the rate of the absorption of light (absorbance) is modulated like GH method. When adopting the 3rd approach of the above, including these methods, liquid crystal thickness is a method used as the main determinants of an optical property, and setting up liquid crystal thickness thickly by the transparency display, and setting up liquid crystal thickness thinly by the reflective display can adopt all the methods that have the effectiveness of good display property implementation.

[0109] The substrate of a pair with which the orientation means was given to the front face on which a liquid crystal display counters as mentioned above in this invention, It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrates of this pair. It is arbitrary and the orientation device for making coincidence take at least two kinds of different orientation conditions is provided to a different field used for the display in the above-mentioned liquid crystal layer. A reflective means is allotted to at least one field among the fields which show a different orientation condition in the above-mentioned liquid crystal layer. The account of a top And the reflective display to which the field which shows a different orientation condition performs a reflective display, By being used for the transparency display which performs a transparency display, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity according to the orientation condition of a liquid crystal layer can be obtained, there is no parallax, and a high contrast ratio can be realized. Consequently, while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired even when an ambient light is strong.

[0110] Moreover, when extent of the amount of modulations of each optical physical quantity, such as the amount of absorption of light and phase contrast by the optical anisotropy, is independently changed by the reflective display and the transparency display, Even when the direction of orientation of the liquid crystal by impression of an electrical potential difference is almost the same in the whole field for using for the display of a liquid crystal layer, in the field in which the liquid crystal thickness of a liquid crystal layer differs Since it has substantially the same operation as the case where the direction of orientation of a liquid crystal layer is changed in this field, the liquid crystal display concerning this invention It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrate of a pair with which the orientation means was given to the front face which counters, and the substrate of this pair. While each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display At least, a reflective means is allotted to a reflective display and the liquid crystal thickness of the above-mentioned reflective display is good for it also as a configuration set up smaller than a transparency display.

[0111] Also in the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible to set up an optical parameter independently by the transparency display and the reflective display. Therefore, according to the above-

mentioned configuration, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired even when an ambient light is strong.

[0112] Hereafter, the gestalt 1 of operation and the gestalt 2 of operation mainly explain especially the liquid crystal display that performs a good transparency display in a good reflective display list by changing liquid crystal thickness by the reflective display and the transparency display.

[0113] [Gestalt 1 of operation] The gestalt of this operation mainly explains below the liquid crystal display which used GH method with reference to drawing 1 .

[0114] Drawing 1 is the important section sectional view of the liquid crystal display concerning the gestalt 1 of this operation. This liquid crystal display is equipped with the back light 13 (lighting system) as a background lighting means if needed while it is equipped with a liquid crystal cell 100 (liquid crystal display component), as shown in drawing 1 . These liquid crystal cells 100 and a back light 13 are arranged in order of the liquid crystal cell 100 and the back light 13 from the observer (user) side.

[0115] The electrode substrate 101 (the 1st substrate) with which the liquid crystal layer 1 equipped with the orientation film 2 the side (interface on the 1st substrate which touches the liquid crystal layer 1) which touches this liquid crystal layer 1 as a liquid crystal cell 100 was shown in drawing 1 , It has the configuration pinched by the electrode substrate 102 (the 2nd substrate) which equipped with the orientation film 3 the side (interface on the 2nd substrate which touches the liquid crystal layer 1) which touches the liquid crystal layer 1.

[0116] The electrode 6 (electrical-potential-difference impression means) for impressing an electrical potential difference to the liquid crystal layer 1 is formed on the substrate 4 which turns into the above-mentioned electrode substrate 101 from the glass substrate which has translucency, and the orientation film 2 (orientation device) with which rubbing processing was performed is formed so that this electrode 6 may be covered.

[0117] On the other hand, the electrode 7 (electrical-potential-difference impression means) as a counterelectrode which counters an electrode 6 is formed through the insulator layer 11 at the above-mentioned electrode substrate 102 which countered the above-mentioned electrode substrate 101 and was formed on both sides of the liquid crystal layer 1 on the substrate 5 which has translucency in the liquid crystal layer 1 that an electrical potential difference should be impressed.

[0118] The above-mentioned insulator layer 11 is formed in the field corresponding to the field used for the display in the above-mentioned liquid crystal layer 1 so that it may have partially different thickness, so that the field used for the display in the above-mentioned liquid crystal layer 1 may have at least two kinds (the gestalt of this operation two kinds) of different liquid crystal thickness. In more detail, the above-mentioned insulator layer 11 is a field corresponding to the transparency display 10, and it is formed so that thickness may become thin rather than the field corresponding to the reflective display 9.

[0119] The wrap reflective film 8 (reflective means) is formed in the field corresponding to the reflective display 9 in the above-mentioned electrode substrate 102 in the above-mentioned electrode 7, and further, the orientation film 3 (orientation device) with which rubbing processing was performed is formed in it so that the reflective film 8 may be covered in these electrode 7 list.

[0120] Here, an electrode 6-7 is a transparent electrode formed of ITO (indium tin oxide). Moreover, a display is controlled by the electrical potential difference which the electrical potential difference for making the liquid crystal layer 1 produce electric field was impressed to the electrode 6-7, and was based on the contents of a display being impressed.

[0121] Moreover, the reflective film 8 has light reflex nature, for example, is produced by metals, such as aluminum and silver, the dielectric multilayer reflecting mirror, etc. When the reflective film 8 is produced with a conductor, this reflective film 8 may be holding an additional post of the function as an electrode instead of an electrode 7. That is, the reflective film 8 may be a reflective pixel electrode which serves both as the liquid crystal drive electrode which drives the liquid crystal layer 1, and a reflective means. Furthermore, the above-mentioned reflective film 8 may be color reflective film which reflects the light

of the wavelength band suitably chosen from the light.

[0122] In addition, the quality of the material, the formation approach, etc. of each part material which constitute the above-mentioned electrode substrate 101-102 are not necessarily limited to the above-mentioned publication, and a well-known ingredient and the approach in ordinary use can be conventionally used for them. Moreover, the configuration of the above-mentioned liquid crystal display is not limited to the above-mentioned configuration, either, and you may have directly the configuration with which an electrical potential difference is impressed to the electrode 6-7 corresponding to the reflective display 9 and the transparency display 10 from the exterior of a liquid crystal cell 100 with the signal from the touch panel (press coordinate detection blocking force means) explained with the gestalt of operation mentioned later. Moreover, you may have the configuration in which active components, such as a TFT component and MIM, are prepared as a switching element.

[0123] As the above-mentioned electrode substrate 101-102 is shown in drawing 1 , the liquid crystal layer 1 is formed by carrying out opposite arrangement so that the orientation film 2-3 may counter, being stuck using an enclosure sealing compound etc., and introducing a liquid crystal constituent into the opening.

[0124] Moreover, a back light 13 is seen from an observer (user), and is arranged at the tooth-back, i.e., electrode substrate 102 rear face, side of the above-mentioned liquid crystal cell 100. This back light 13 is mainly constituted by light source 13a and transparent material 13b. Light source 13a is arranged along the side face of for example, transparent material 13b, and, thereby, transparent material 13b carries out outgoing radiation of the light which made the side face by the side of light source 13a arrangement plane of incidence, and carried out incidence from light source 13a to the liquid crystal cell 100 which is an illuminated object. In addition, the existing lighting system can be used as the above-mentioned back light 13.

[0125] In the liquid crystal display which has the above-mentioned configuration, it displays on the screen from a substrate 4, i.e., observer, side by the reflective display 9 in which the reflective film 8 was formed by controlling by change of liquid crystal orientation the reflectivity of the ambient light which carries out incidence. Moreover, in the transparency display 10 in which the reflective film 8 is not formed, it displays on the screen from a substrate 5 side by controlling by change of liquid crystal orientation the transmitted light reinforcement of the light which carries out incidence. In this case, the illumination light by the back light 13 installed in liquid crystal cell 100 tooth back may be used if needed.

[0126] The above-mentioned liquid crystal display shown in drawing 1 is produced by liquid crystal thickness which is different by the reflective display 9 and the transparency display 10 as mentioned above. Thereby, the above-mentioned liquid crystal display has liquid crystal orientation which is substantially different by the reflective display 9 and the transparency display 10.

[0127] Here, the configuration of the liquid crystal display for obtaining liquid crystal thickness which is different by the reflective display 9 and the transparency display 10 is explained below.

[0128] What is necessary is just to form so that it may have thickness which is different by the reflective display 9 and the transparency display 10 in an insulator layer 11 as shown in drawing 1 in order to obtain liquid crystal thickness which is different by the reflective display 9 and the transparency display 10.

[0129] in addition, the substrate (namely, the above-mentioned electrode substrate 101-102) with which the configuration for changing liquid crystal thickness by the reflective display 9 and the transparency display 10 is pinching liquid crystal -- at least -- either -- even having -- what is necessary is just to be

[0130] Therefore, the above-mentioned insulator layer 11 may be allotted not on the substrate 5 but on the substrate 4. However, even if it is such a case, the reflective film 8 is formed on the substrate 5 by the side of the electrode substrate 102 (namely, pinching the liquid crystal layer 1 with a screen side (electrode substrate 101 side) opposite side).

[0131] In addition, although considered as the configuration to which liquid crystal thickness is changed

by the reflective display 9 and the transparency display 10 by changing the thickness of an insulator layer 11 in the liquid crystal display shown in drawing 1 in the field corresponding to the reflective display 9 in an insulator layer 11, and the field corresponding to the transparency display 10 It is good also as a configuration to which liquid crystal thickness is changed by the reflective display 9 and the transparency display 10 by forming a substrate 4 or substrate 5 itself in the same configuration as the insulator layer 11 shown in drawing 1 .

[0132] In moreover, the field corresponding to the reflective display 9 in an insulator layer 11 and the field corresponding to the transparency display 10 When changing the thickness, as shown in drawing 1 , the insulator layer 11 of the field corresponding to the transparency display 10 It is good also as a configuration by which you may form so that it may become thinner than the thickness of the insulator layer 11 of the field corresponding to the reflective display 9, or the insulator layer 11 is formed in the field corresponding to the reflective display 9, and the insulator layer 11 is not formed in the field corresponding to the transparency display 10.

[0133] Furthermore, in order to maintain the liquid crystal thickness of the liquid crystal layer 1 in the reflective display 9 and the transparency display 10 at a predetermined value, a spacer (not shown) may be arranged on the liquid crystal layer 1, and liquid crystal thickness may be maintained at the predetermined value by other technique. For example, when arranging a spherical spacer on the liquid crystal layer 1, the liquid crystal thickness in the reflective display 9 with thin liquid crystal thickness turns into thickness almost equal to the diameter of this spacer.

[0134] As mentioned above, the substrate pair 1 prepared as mentioned above, i.e., the liquid crystal layer pinched by the above-mentioned electrode substrate 101-102, consists of a liquid crystal constituent. While use the liquid crystal constituent which made dichroism coloring matter 12 mix in liquid crystal, making the liquid crystal layer 1 produce electric field and controlling [as a liquid crystal display method by this liquid crystal layer 1,] liquid crystal orientation to be shown in drawing 1 , for example, the direction of orientation of dichroism coloring matter 12 can be changed to coincidence, and GH method which displays using change of the absorption coefficient by dichroism can be used.

[0135] Next, a display principle in case the liquid crystal thickness in the reflective display 9 differs from the liquid crystal thickness in the transparency display 10 is explained to actuation of the liquid crystal layer 1 by GH method, and a list below with reference to drawing 1 .

[0136] When displaying using the liquid crystal display shown in drawing 1 , as an arrow head shows, it displays at the transparency display 10 by passing the liquid crystal layer 1 only at once, carrying out outgoing radiation of the light from back light 13 grade and liquid crystal layer 1 back from the screen, and making it into display light. As for the dichroism coloring matter 12 mixed into the liquid crystal constituent arranged on the liquid crystal layer 1, the rate of the absorption of light changes with liquid crystal orientation at this time. for this reason, as shown in transparency display 10a, while liquid crystal is carrying out orientation (parallel orientation is called hereafter) of the transparency display 10 in parallel to the screen (electrode substrate 101) As it becomes a dark display since the dichroism coloring matter 12 in this part absorbs strongly the light which passes the liquid crystal layer 1, and shown in transparency display 10b While liquid crystal is carrying out orientation (perpendicular orientation is called hereafter) perpendicularly to the screen (electrode substrate 101), since the absorption of light by dichroism coloring matter 12 is weak, it becomes clear display and a display becomes possible.

[0137] On the other hand, in the reflective display 9, the light which carried out incidence to the screen from the observer side is used for a display. That is, as an arrow head shows, after the light which carried out incidence to the screen passes the liquid crystal layer 1, it is reflected by the reflective film 8, and it passes the liquid crystal layer 1 again, it carries out outgoing radiation from the screen, and it turns into display light. As the reflective display 9 is shown in reflective display 9a at this time, while liquid crystal is carrying out parallel orientation, as it becomes a dark display since the dichroism coloring matter 12 in this part absorbs light strongly and is shown in reflective display 9b, while liquid

crystal is carrying out perpendicular orientation, since the absorption of light by dichroism coloring matter 12 is weak, it becomes clear display and a display becomes possible.

[0138] Therefore, clear display and a dark display are attained by giving the potential difference between an electrode 6 and an electrode 7, and controlling liquid crystal orientation. In addition, when especially the initial orientation condition of liquid crystal is not limited and an electrical potential difference is not impressed [for example,] in this case, parallel orientation may be carried out, you may be twisting further, and conversely, when not impressing an electrical potential difference, perpendicular orientation may be carried out. In the case of the former, a dielectric constant anisotropy can use forward liquid crystal for liquid crystal (namely, when the liquid crystal orientation when not impressing an electrical potential difference is parallel orientation or it is twisting further). On the other hand, in the case of the latter, as liquid crystal, a dielectric constant anisotropy can use negative liquid crystal (namely, when the liquid crystal orientation when not impressing an electrical potential difference is perpendicular orientation). Thus, although especially the initial orientation condition of liquid crystal is not limited, it needs to adjust the thickness of an insulator layer 11 so that the liquid crystal thickness suitable for the gestalt of the liquid crystal orientation to be used may be obtained.

[0139] Moreover, as shown in drawing 1 , in order to produce the liquid crystal layer 1 easily, it is desirable to have the structure which the liquid crystal layer 1 opened for free passage over the reflective display 9 and the transparency display 10, or two or more display pixels like the usual liquid crystal display.

[0140] Thus, even if it is the case where the liquid crystal layer 1 is open for free passage between the reflective display 9 and the transparency display 10 Distance when liquid crystal thickness differs by the transparency display 10 and the reflective display 9, while display light and the becoming light finally pass the liquid crystal layer 1 It becomes possible to set up almost similarly in the distance in which this light passes the liquid crystal layer 1 only at once in the transparency display 10, and the distance in which this light goes and comes back to the liquid crystal layer 1 in the reflective display 9.

[0141] For this reason, while the reflective lightness of the reflective display 9 and the transparency lightness of the transparency display 10 can set up almost to the same extent, the contrast ratio in the reflective display 9 and the contrast ratio in the transparency display 10 can be set up almost to the same extent. If it puts in another way, in GH method using the absorption of light by dichroism coloring matter 12, changing liquid crystal thickness by the reflective display 9 and the transparency display 10 Since there is the same effectiveness as the case where coloring matter concentration is changed, substantially, by changing liquid crystal thickness by the transparency display 10 and the reflective display 9 Mixing concentration of the dichroism coloring matter 12 suitable for the reflective display 9 to a liquid crystal constituent and mixing concentration of the dichroism coloring matter 12 suitable for the transparency display 10 can be made almost equal. Therefore, the reflective display 9 and the transparency display 10 can realize a good display to coincidence by the liquid crystal layer 1 which the reflective display 9 and the transparency display 10 are opening for free passage. That is, by the reflective display 9 and the transparency display 10, a display contrast ratio is comparable and the lightness of clear display also becomes comparable.

[0142] In addition, the lightness in this case shall show the rate observed by the observer as a display light in the reflective display 9 or the transparency display 10 among the light which carries out incidence to the liquid crystal layer 1, and a contrast ratio shall ** and define the lightness of clear display by lightness of a dark display.

[0143] Moreover, when the contrast ratio suitable for a reflective display is generally compared with the contrast ratio suitable for a transparency display, it is required that the contrast ratio suitable for a transparency display should be higher than the contrast ratio suitable for a reflective display. Therefore, in order to fill this demand, it is more effective rather than setting up equally the contrast ratio in the reflective display 9, and the contrast ratio in the transparency display 10 the liquid crystal thickness in the transparency display 10 is set up more thickly than the liquid crystal thickness in the reflective

display 9, and the contrast ratio in the transparency display 10 exceeds the contrast ratio in the reflective display 9, when performing a good display.
[0144] Although a concrete example and the example of a comparison are hereafter given and explained with reference to drawing 1 - drawing 3 about the liquid crystal display concerning the gestalt of this operation based on the display principle mentioned above, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0145] [Example 1] By this example, by liquid crystal's carrying out orientation almost perpendicularly to a screen normal, while not impressing the electrical potential difference to the liquid crystal layer 1, and impressing an electrical potential difference to the liquid crystal layer 1, liquid crystal inclines to the screen and the liquid crystal display with which the dielectric constant anisotropy which carries out orientation uses the liquid crystal layer 1 of GH method using negative liquid crystal for a display is explained. First, the manufacture approach of this liquid crystal display is explained below.
[0146] first, it was alike on the transparent substrate 4, and 140nm of ITO(s) was formed by sputtering, and the electrode 6 (transparent electrode) of a predetermined pattern was produced by carrying out etching processing using photolithography. In addition, the glass substrate was used as the above-mentioned substrate 4.
[0147] Next, the orientation film 2 was formed on the electrode 6 forming face in this substrate 4 by arranging the perpendicular orientation film by offset printing, and calcinating this in 200-degree C oven further. Then, orientation processing was performed to the orientation film 2 by rubbing, and the electrode substrate 101 as an observer side substrate was produced.
[0148] Here, the perpendicular orientation film has the property to which normal bearing of a film surface is made to carry out orientation of the liquid crystal, and has further the property to which abundance extent inclination orientation of the liquid crystal orientation is carried out [the] from a normal by orientation processing of rubbing etc. The liquid crystal orientation after electrical-potential-difference impression inclines still more greatly toward the above-mentioned orientation processing direction for this inclination.
[0149] On the other hand, the sensitization resin which has insulation was applied with the spin coat on the substrate 5, sensitization resin did not remain in the transparency display 10 by the mask exposure of ultraviolet radiation further, but in the reflective display 9, pattern formation of the insulator layer 11 was carried out so that it might be formed at the thickness this whose sensitization resin is 3 micrometers. At this time, the electrode 7 formed at a back process formed the pattern edge part of an insulator layer 11 in the level difference configuration gently-sloping enough so that plasmotomy might not be carried out by the level difference of this insulator layer 11. In addition, the substrate 4 and the same transparent glass substrate were used for the above-mentioned substrate 5.
[0150] Furthermore, 140nm of ITO(s) was formed by sputtering on the insulator layer 11 forming face in this substrate 5, and 200nm of aluminum which functions as an electrode of light reflex nature was further formed by sputtering on it. Subsequently, patterning of the obtained aluminum film was carried out by photolithography and dry etching so that this aluminum film might remain only in the reflective display 9 (namely, part which made sensitization resin remain in case patterning of the sensitization resin was carried out that an insulator layer 11 should be formed), and the reflective film 8 was formed. And the electrode 7 (transparent electrode) of a predetermined pattern was further produced by carrying out etching processing of the lower layer ITO film of this reflective film 8 using photolithography.
[0151] Next, the orientation film 3 was formed by the same approach as the orientation film 2 of the above-mentioned electrode substrate 101 which is an observer side substrate on the above-mentioned electrode 7 in this substrate 5, and the reflective film 8 forming face. Then, orientation processing was performed to the above-mentioned orientation film 3 by rubbing, and the electrode substrate 102 was produced.
[0152] Among the electrode substrates 101-102 produced as mentioned above, around one electrode substrate, the seal resin (not shown) as an enclosure sealing compound was arranged, on the orientation

film forming face in the electrode substrate of another side, as a spherical plastic spacer with a diameter of 4.5 micrometers was sprinkled and it was shown in drawing 1 , the electrode surface was made to counter, seal resin was hardened under pressurization, and the liquid crystal cell for liquid crystal impregnation was produced. When the thickness (namely, thickness of the liquid crystal layer 1) of the opening for liquid crystal impregnation in the reflective display 9 and the transparency display 10 of a liquid crystal cell for this liquid crystal impregnation was measured by measurement of a reflected light spectrum, in the reflective display 9, it was 7.5 micrometers at 4.5 micrometers and the transparency display 10.

[0153] Furthermore, when the dielectric constant anisotropy introduced into the liquid crystal cell for the above-mentioned liquid crystal impregnation the liquid crystal constituent which comes to mix dichroism coloring matter 12 in negative liquid crystal, the concentration of dichroism coloring matter 12 was adjusted to concentration from which sufficient contrast ratio is obtained by the reflective display 9 and the transparency display 10. Furthermore, the chiral additive which gives a twist to the orientation of liquid crystal was added to the above-mentioned liquid crystal constituent, and with the orientation processing performed to the orientation film 2-3, by the reflective display 9 and the transparency display 10 in an electrical-potential-difference impression condition which are used for a dark display, the twist of the liquid crystal orientation between the electrode substrates 101.102 of the upper and lower sides of the liquid crystal layer 1 set it as it so that it might become the same. Furthermore, the liquid crystal constituent was introduced into the liquid crystal cell for the above-mentioned liquid crystal impregnation by the vacuum pouring-in method, and the liquid crystal display was produced.

[0154] When the electrical potential difference was impressed to the liquid crystal layer 1, measuring the reflection factor of the reflective display 9 in the obtained liquid crystal display, and the permeability of the transparency display 10 under a microscope, the display property shown in drawing 2 R> 2 was acquired. The electrical potential difference impressed to the liquid crystal layer 1 is a square wave currently inverted every 17msec, in drawing 2 , an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, in this drawing, a curve 111 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9, and a curve 112 shows the electrical-potential-difference dependency of the permeability of the transparency display 10.

[0155] As shown in a curve 111 and a curve 112, in the above-mentioned liquid crystal display, the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is both falling with impression of an electrical potential difference. Moreover, when applied voltage was 1.8V, the reflection factor of the reflective display 9 was 55%, the permeability of the transparency display 10 was 52%, and when applied voltage was 5V, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 was 10% 11%.

[0156] That is, according to the above-mentioned liquid crystal display, while the high value to which the lightness of clear display both exceeds 50% also to the transparency display 10 is shown also to the reflective display 9, a contrast ratio is about 5, and the display excellent in visibility was able to be realized.

[0157] [Example 1 of a comparison] Here, the example of a comparison of the above-mentioned example 1 is shown. In this example 1 of a comparison, the liquid crystal display for a comparison was produced according to the manufacture approach of the liquid crystal display shown in an example 1 in the liquid crystal display using GH method shown in an example 1 except having designed so that the liquid crystal thickness in the reflective display 9 and the liquid crystal thickness in the transparency display 10 might become the same.

[0158] In this example of a comparison, the insulator layer 11 which was produced on the substrate 5 of an example 1 was not produced, but, more specifically, both the liquid crystal thickness in the reflective display 9 and the liquid crystal thickness in the transparency display 10 produced the liquid crystal display which is 4.5 micrometers. That is, the electrode substrate of the upper and lower sides which

counter on both sides of the liquid crystal layer 1 produced the liquid crystal display by both producing the smooth liquid crystal cell for liquid crystal impregnation by the reflective display 9 and the transparency display 10, and introducing the liquid crystal constituent which mixed the same dichroism coloring matter 12 and same chiral additive as an example 1 in the liquid crystal cell for this liquid crystal impregnation.

[0159] The display property which measured the reflection factor of the reflective display 9 and the permeability of the transparency display 10 in the obtained liquid crystal display by the same approach as an example 1, and was acquired is shown in drawing 3 .

[0160] [Example 2 of a comparison] In this example 2 of a comparison, the liquid crystal display set as the same liquid crystal cell as the example 1 of a comparison so that the liquid crystal constituent which made concentration of dichroism coloring matter 12 high might be introduced and the lightness and the contrast ratio of the transparency display 10 might become the optimal from the example 1 of a comparison was produced.

[0161] The display property which measured the reflection factor of the reflective display 9 and the permeability of the transparency display 10 in the obtained liquid crystal display by the same approach as an example 1, and was acquired is combined with the result of the example 1 of a comparison, and is shown in drawing 3 .

[0162] In drawing 3 , an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, in this drawing, a curve 121 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 of the example 1 of a comparison, and a curve 122 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 of the example 1 of a comparison. Moreover, a curve 123 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 of the example 2 of a comparison, and a curve 124 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 of the example 2 of a comparison.

[0163] As shown in a curve 121 and a curve 122, although the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is falling with impression of an electrical potential difference, with the liquid crystal display obtained in the example 1 of a comparison, both The permeability of the transparency display 10 was 66% to the reflection factor of the reflective display 9 in case applied voltage is 1.8V having been 51%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 22% 11%.

[0164] That is, according to the liquid crystal display obtained in the above-mentioned example 1 of a comparison, in the reflective display 9, although the high lightness exceeding 50% and about five contrast ratio were obtained, since the liquid crystal thickness in this transparency display 10 was the same as the liquid crystal thickness in the reflective display 9 in the transparency display 10, although the lightness of the liquid crystal layer 1 was high, the contrast ratio was as low as about three, and display grace was low.

[0165] Moreover, both, as shown in a curve 123 and a curve 124, although the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is falling with the fall of an electrical potential difference, with the liquid crystal display obtained in the example 2 of a comparison The permeability of the transparency display 10 was 51% to the reflection factor of the reflective display 9 in case applied voltage is 1.8V having been 29%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 10% 3%.

[0166] That is, according to the liquid crystal display obtained in the above-mentioned example 2 of a comparison, although the high lightness exceeding 50% and about five contrast ratio were obtained, since the liquid crystal thickness in this reflective display 9 was the same as the liquid crystal thickness in the transparency display 10 in the reflective display 9, although the contrast ratio was as high as about ten,

lightness did not fill it with the transparency display 10 to 30%, but it became a dark display by it.
[0167] clear from the comparison with the above-mentioned example 1 and the example 1-2 of a comparison -- as -- the liquid crystal display of GH method -- setting -- the contrast ratio of the transparency display 10 -- the contrast ratio and EQC of the reflective display 9 -- or in order to have made it higher, it turned out that it is effective to set up more greatly than the thickness of the liquid crystal layer 1 of the reflective display 9 the thickness of the liquid crystal layer 1 of the transparency display 10.
[0168] [Gestalt 2 of operation] As a liquid crystal display method concerning this invention, although the gestalt 1 of said operation explained the liquid crystal display which used GH method, as shown in drawing 4 , a substrate 4 and 5 may be pinched by the polarizing plate 14 and 15, and the method which uses the retardation and rotatory polarization (it is hereafter written as a polarization conversion operation collectively) of the liquid crystal layer 1 for a display may be adopted besides the above-mentioned GH method.
[0169] So, the gestalt of this operation mainly explains below the liquid crystal display which used the above-mentioned polarization conversion operation for the display with reference to drawing 4 . In addition, the same number is given to the component which has the function as the gestalt 1 of said operation of explanation same for convenience, and the explanation is omitted.
[0170] Drawing 4 is the important section sectional view of the liquid crystal display concerning the gestalt of this operation. The liquid crystal display shown in drawing 4 is equipped with said back light 13 (lighting system) if needed while it is equipped with a liquid crystal cell 200 (liquid crystal display component). These liquid crystal cells 200 and a back light 13 are arranged in order of the liquid crystal cell 200 and the back light 13 from the observer (user) side.
[0171] The electrode substrate 201 (the 1st substrate) with which the liquid crystal layer 1 equipped with the orientation film 2 the side (interface on the 1st substrate which touches the liquid crystal layer 1) which touches this liquid crystal layer 1 as a liquid crystal cell 200 was shown in drawing 4 , It is pinched by the electrode substrate 202 (the 2nd substrate) which equipped with the orientation film 3 the side (interface on the 2nd substrate which touches the liquid crystal layer 1) which touches the liquid crystal layer 1. Furthermore, while equipping the outside (namely, the opposed face with the electrode substrate 202 opposite side) of the electrode substrate 201 with the phase contrast compensating plate 16 and a polarizing plate 14 It has the configuration which equipped the outside (namely, the opposed face with the electrode substrate 201 opposite side) of the electrode substrate 202 with the phase contrast compensating plate 17 and the polarizing plate 15. In addition, the above-mentioned phase contrast compensating plate 16-17 is used if needed, being prepared.
[0172] Various phase contrast compensating plates, such as an extension high polymer film, a liquid crystal orientation fixed high polymer film, and a liquid crystallinity high polymer film, can be used for the above-mentioned phase contrast compensating plate 16-17 used if needed in this invention. The optical operation is used for modification of the dependency of the lightness over prevention of the coloring often seen and the potential difference of an electrode 6-7, and a pan for modification of a display angle of visibility etc., when it does not have the phase contrast compensating plate 16-17 used.
[0173] Moreover, the electrode 6 for impressing an electrical potential difference to the liquid crystal layer 1 is formed on the substrate 4 which turns into the above-mentioned electrode substrate 201 from the glass substrate which has translucency, and the orientation film 2 with which rubbing processing was performed is formed so that this electrode 6 may be covered.
[0174] On the other hand, the electrode 7 as a counterelectrode which counters an electrode 6 is formed through the insulator layer 11 at the above-mentioned electrode substrate 202 which countered the above-mentioned electrode substrate 201 and was formed on both sides of the liquid crystal layer 1 on the substrate 5 which has translucency in the liquid crystal layer 1 that an electrical potential difference should be impressed. However, in the liquid crystal display shown in drawing 4 , it has a configuration to which the electrode 7 in the reflective display 9 and the electrode 7 in the transparency

display 10 are insulated electrically, and an electrical potential difference is separately impressed from the liquid crystal cell outside. And the reflective film 8 is formed in the field corresponding to the reflective display 9 in the above-mentioned electrode substrate 202, and further, the orientation film 3 with which rubbing processing was performed is formed in it so that the reflective film 8 may be covered in these electrode 7 list. Moreover, the above-mentioned insulator layer 11 is formed so that the thickness of the field corresponding to the transparency display 10 in this insulator layer 11 may become thinner than the thickness of the field corresponding to the reflective display 9.

[0175] As the above-mentioned electrode substrate 201-202 is shown in drawing 4 , the liquid crystal layer 1 is formed by carrying out opposite arrangement so that the orientation film 2 and the orientation film 3 may counter, being stuck using an enclosure sealing compound etc., and introducing a liquid crystal constituent into the opening.

[0176] In the above-mentioned liquid crystal display, the liquid crystal layer 1 which consists of a liquid crystal constituent mentioned above has the structure which was open for free passage between the reflective display 9 and the transparency display 10 in clear display. In drawing 4 , as shown in reflective display 9b and transparency display 10b, while carrying out parallel orientation of the liquid crystal of this liquid crystal layer 1, a polarization conversion operation arises to the light which passes the liquid crystal layer 1, and it serves as a dark display. On the other hand, as shown in reflective display 9a and transparency display 10a, while the liquid crystal of the liquid crystal layer 1 is carrying out perpendicular orientation, a polarization conversion operation is weak and serves as clear display.

[0177] Therefore, clear display and a dark display are attained by using the orientation change in reflective display 9aand9b, and transparency display 10a and 10b for a display as display luminous-intensity change in the linearly polarized light selection transparency operation by the polarizing plate 14 by the side of the screen which pinches the liquid crystal layer 1 and is arranged, and the polarizing plate 15 by the side of a back light 13. In addition, as mentioned above, in order to compensate the wavelength dependency of the refractive-index difference of the liquid crystal layer 1 in this case, in order to change the electrical-potential-difference dependency of the lightness modulated in the liquid crystal layer 1 if needed, or in order to change the angle of visibility of a display, the phase contrast compensating plate 16-17 as shown in drawing 4 may be used.

[0178] Thus, also when using an optical anisotropy for a display, especially the initial orientation condition of liquid crystal may not be limited, may be in the condition in which the liquid crystal layer 1 in electrical-potential-difference the condition of not impressing carried out orientation in parallel to the screen, and may be in the condition which carried out orientation perpendicularly. In the case of the former, a dielectric constant anisotropy can use forward liquid crystal for liquid crystal (namely, when the liquid crystal orientation in electrical-potential-difference the condition of not impressing is parallel orientation). On the other hand, in the case of the latter, as liquid crystal, a dielectric constant anisotropy can use negative liquid crystal (namely, when the liquid crystal orientation in electrical-potential-difference the condition of not impressing is perpendicular orientation).

[0179] Thus, also when using an optical anisotropy for a display, it is effective [a condition], although especially the initial orientation condition of liquid crystal is not limited to adjust the thickness of an insulator layer 11 so that the liquid crystal thickness suitable for the gestalt of the liquid crystal orientation to be used may be obtained.

[0180] In order to realize a dark display by the above-mentioned reflective display 9, the light made into the linearly polarized light with the polarizing plate 14 is prepared first. And if needed, with the phase contrast compensating plate 16, a polarization condition is changed, and rather than the transparency display 10, thickness is the liquid crystal layer 1 of the reflective display 9 set up thinly, and changes a polarization condition further. this time -- conditions required for an ideal dark display -- as a result -- the polarization condition on the reflective film 8 -- right and left -- it is considering as the circular polarization of light which may be the surroundings of which. Moreover, conditions required in order to realize ideal clear display by the same reflective display 9 are making the polarization condition on the

reflective film 8 into the linearly polarized light. And the change of a display will be attained if liquid crystal orientation is electrically controllable between this dark display and clear display.

[0181] That is, the phase contrast which the liquid crystal layer 1 will give to light by the time the light which carried out incidence to the liquid crystal layer 1 reaches the reflective film 8, when realizing a dark display (phase contrast of the display light on the reflective film 8), Between the phase contrast (phase contrast of the display light on the reflective film 8) which the liquid crystal layer 1 will give to light by the time the light which carried out incidence to the liquid crystal layer 1 reaches the reflective film 8, when realizing clear display the liquid crystal orientation which there is a difference in quarter-wave length (in general 90 degrees) substantially, and realizes it -- for example, between the circular polarization of light [in / electrically / controllable, i.e., a dark display,], and the linearly polarized lights in clear display -- controllable -- ****ing . At this time, polarization bearing of the linearly polarized light on the reflective film 8 which realizes clear display is good in the bearing of arbitration.

[0182] Moreover, a display is performed by making it change in the liquid crystal layer 1 with which the light made into the linearly polarized light with the polarizing plate 15 in the transparency display 10 changed the polarization condition with the phase contrast compensating plate 17 if needed, and thickness was subsequently thickly set up rather than the reflective display 9, making it change with phase contrast compensating plates 16 further if needed, and carrying out outgoing radiation from a polarizing plate 14.

[0183] In this case, it is change of a polarization condition just before carrying out incidence to a polarizing plate 14 which is used for a display. Therefore, what is necessary is just to adjust a polarization condition just before carrying out incidence to a polarizing plate 14 that what is necessary is just to adjust a polarization condition just before carrying out incidence to a polarizing plate 14 so that it may become the linearly polarized light which has the oscillating direction of transparency shaft bearing of a polarizing plate 14 in performing clear display, so that it may become the linearly polarized light which has the plane of vibration of absorption shaft bearing of a polarizing plate 14 in performing a dark display.

[0184] That is, the phase contrast given to the light which passes the liquid crystal layer 1 of the transparency display 10 when performing clear display (phase contrast of the display light which carries out outgoing radiation of the liquid crystal layer 1), A difference with the phase contrast (phase contrast of the display light which carries out outgoing radiation of the liquid crystal layer 1) given to the light which passes the liquid crystal layer 1 of the transparency display 10 when performing a dark display It is possible to change a display, if change of the orientation of the liquid crystal layer 1 is electrically controlled by impression of an electrical potential difference to become 1/2 wave (in general 180 degrees) substantially.

[0185] Are equivalent to controlling polarization bearing of the linearly polarized light which carries out incidence to a polarizing plate 14 from the liquid crystal layer 1 side with 1/2 wave of phase control here. It is the polarization conversion operation not only including control of the phase contrast by the retardation in which the refractive-index main shaft carried out orientation in parallel uniformly but the rotatory-polarization phenomenon in which the refractive-index main shaft of the liquid crystal layer 1 is twisted in connection with a twist of liquid crystal orientation, and polarization bearing of the linearly polarized light changes with change by the electrical potential difference of a twist of the orientation etc. When a polarization conversion operation of the liquid crystal layer 1 which realizes this also takes into consideration application of the phase contrast compensating plate 16 or the phase contrast compensating plate 17, it is a polarization conversion operation between the general polarization conditions which intersected perpendicularly.

[0186] The liquid crystal orientation which enables the polarization conversion operation which realizes control (phase control of light) of the above polarization conditions You may be parallel (parallel to the screen), and uniform parallel orientation (homogeneous orientation) at a substrate 4-5. the orientation (twist orientation) twisted to the substrate 4-5 between parallel (parallel to the screen), and a substrate

4-5 (between the vertical substrates which countered on both sides of the liquid crystal layer 1) -- you may be -- moreover, the substrate 4-5 -- a perpendicular (perpendicular to the screen) -- you may be perpendicular orientation (homeotropic orientation). Furthermore, one interface of the liquid crystal layer 1 is parallel orientation, and the hybrid orientation whose another side is perpendicular orientation is available.
[0187] In this case, it is desirable for it to be set as 60 degrees or more and 100 degrees or less between the above-mentioned substrates 4-5, or to specifically be set as 0 times or more and 40 degrees or less as the above-mentioned twist orientation. Even if this reason does not change rubbing bearing by the transparency display 10 and the reflective display 9, it is because it becomes possible to reconcile the conditions suitable for the conditions suitable for the reflective display 9, and the transparency display 10.
[0188] When mass-producing a liquid crystal display, it is the design which changes as an optical design of the most desirable liquid crystal layer 1 between the upper limits of the range of driver voltage and minimums which are impressed to the liquid crystal layer 1 so that display lightness (a reflection factor or permeability) may monotone-increase or monotone decrease.
[0189] When taking the conditions of the above drive into consideration, the optical design of the simplest liquid crystal layer 1 is a design by which the electro-optics property that a display is controlled between the liquid crystal which carried out orientation to the screen perpendicularly substantially, and the liquid crystal which carried out orientation to the screen in parallel substantially so that display lightness increases [monotone-] or decreases [monotone-] is attained.
[0190] In this case, when the parallel orientation film is used and liquid crystal orientation parallel to the screen as non-impressed electrical-potential-difference liquid crystal orientation is realized especially, the conditions suitable for a reflective display and the conditions suitable for a transparency display exist clearly. Then, it is the so-called Jones about this condition. It asked by count by the matrix method, and asked for the range where a twist angle is suitable.
[0191] Consequently, in order to obtain a good display by reflective display, it became clear that the twist angle needs to be set as 0 times or more and 100 degrees or less.
[0192] that is, an invention-in-this-application person etc. first in the liquid crystal layer 1 which realizes a good display in a reflective display In order to find out that the operation which changes the circular polarization of light into the linearly polarized light efficiently is required in the liquid crystal orientation (it is substantially equal to the liquid crystal orientation in [electrical-potential-difference] not impressing when the parallel orientation film is used) which has a polarization conversion operation and to evaluate this It asked for the reflection factor at the time of carrying out incidence of the circular polarization of light to the liquid crystal layer 1 with the above-mentioned calculus. In addition, count asked for the reflection factor of the light to which incidence was carried out to the liquid crystal cell 200 at the order of the phase contrast compensating plate 16 which gives the phase contrast of 14 or 90 polarizing plates, the liquid crystal layer 1, and the reflective film 8, and light spread from the reflective film 8 to the polarizing plate 14, and carried out outgoing radiation of this conversely.
[0193] Consequently, it became clear by adjusting the refractive-index difference (deltan) of the liquid crystal of the liquid crystal layer 1, and a product (deltan-d) with liquid crystal thickness (d) for every twist angle of the liquid crystal layer 1 for a twist angle to be able to change the circular polarization of light into the perfect linearly polarized light within the limits of 0 times or more and 70 degrees or less. Moreover, although the circular polarization of light could not be made into the perfect linearly polarized light by within the limits to 100 degrees more than 70 degrees, the good display found out the possible thing. and a twist angle [in / by adjusting deltan-d of the liquid crystal layer 1 for every twist angle, when a twist angle makes 100% maximum in the visible wavelength of the reflection factor to 70 degrees / specific wavelength] -- 97%, 83%, a twist angle becomes 72% and, as for the reflection factor in 80 degrees, a twist angle can obtain a good reflection factor for the reflection factor in 100 degrees, as for the reflection factor in 90 degrees. However, if a twist angle exceeds 100 degrees, as for the reflection

factor in 110 degrees, a twist angle will become unable [angle] for 54% and a twist angle to become 37% in the reflection factor in 120 degrees, and to polarize the circular polarization of light efficiently to the linearly polarized light, for example. That is, it is required to set up a twist angle within the limits of 0 times or more and 100 degrees or less in the liquid crystal layer 1 in the reflective display 9.

[0194] In addition, in the above-mentioned explanation, in order to evaluate a polarization conversion operation of the liquid crystal layer 1 in the reflective display 9, the circular polarization of light was used for count, but in an actual display, even if it is not necessary to necessarily carry out incidence of the circular polarization of light to the liquid crystal layer 1 of the reflective display 9, it designs as the liquid crystal layer 1 was mentioned above, and it carries out incidence of the linearly polarized light to this liquid crystal layer 1, a good display can be obtained by the reflective display 9.

[0195] On the other hand, in order to obtain a good display by the transparency display 10, liquid crystal orientation needs to be the orientation where a twist angle is small (0 times or more, 40 degrees or less), or needs to be the orientation where a twist angle is large (60 degrees or more, 110 degrees or less).

[0196] A polarization conversion operation required in order to obtain a good display by the transparency display 10 needs to fulfill a fundamental optical operation (the 1st condition) and the realistic optical operation (the 2nd condition) decided by relation of this fundamental optical operation (the 1st condition) and the reflective display 9.

[0197] In the case of for example, the 1st condition of the above, the reason is liquid crystal orientation (when the parallel orientation film is used) which has a polarization conversion operation. Set for it to be made [orientation / in / electrical-potential-difference / not impressing] substantial, and be, and in the liquid crystal layer 1 in the transparency display 10 A certain polarization (polarization as which it is the linearly polarized light, the circular polarization of light, or elliptically polarized light, and the polarization condition was specified) Polarization which is efficient and intersects perpendicularly with it (in the case of the circular polarization of light and elliptically polarized light which the hand of cut reversed when it was the linearly polarized light and the circular polarization of light the circular polarization of light and the field where the oscillating electric field of light are included cross at right angles in the case of the linearly polarized light, it is the elliptically polarized light of the same ovality the ovality and ellipse main shaft bearing crossed at right angles) It is because the operation changed into the elliptically polarized light which the hand of cut reversed is needed.

[0198] Then, in order that an invention-in-this-application person etc. might evaluate the above-mentioned operation as a property required for the transparency display 10, the polarization conversion operation was searched for with the above-mentioned calculus (Jones matrix method), but [for this reason] if contrary to the range of a required twist angle, especially the limit became clear [that there is nothing].

[0199] Moreover, the 2nd condition of the above is constraint produced in order to use the optical film by the side of the common screen (a polarizing plate 14 and phase contrast compensating plate 16) by the reflective display 9 and the transparency display 10 in this invention. The optical film in the reflective display 9 and the transparency display 10 is set up so that a reflective display may be performed good. And although a setup of a different optical film is possible in a field contrary to the screen of a liquid crystal display, as for this optical film, it is desirable to set it as arrangement which cooperates with the above-mentioned polarizing plate 14 and the phase contrast compensating plate 16 which are an optical film by the side of the screen, and the liquid crystal layer 1 by the side of the transparency display 10, and indicates the transparency display 10 good. In order to perform such a setup, it is only important for a polarization conversion operation of the liquid crystal layer 1 in the transparency display 10 it not only fulfills the 1st condition of the above, but that the circular polarization of light is convertible for the circular polarization of light of the circumference of reverse good or that the linearly polarized light is convertible for the linearly polarized light which intersects perpendicularly good.

[0200] Then, in order to evaluate the concrete conditions with which the 2nd condition of the above

over the liquid crystal layer 1 in the transparency display 10 is filled, when incidence of the circular polarization of light was carried out to the liquid crystal layer 1, it asked for the luminous intensity which becomes the circular polarization of light of the circumference of reverse with the above-mentioned calculus. Count in addition, light As 1st phase contrast compensating plate which gives the phase contrast of 15 or 90 polarizing plates as the 1st polarizing plate It asked for the permeability at the time of spreading at least ** in order of the phase reference compensating plate 17, the phase contrast compensating plate 16 as 2nd phase contrast compensating plate which has the lagging axis which intersected perpendicularly with the 1st phase contrast compensating plate which gives the phase contrast of 1 or 90 liquid crystal layers, and the polarizing plate 14 as the 1st polarizing plate of the above, and the 2nd polarizing plate which intersects perpendicularly.

[0201] Consequently, the invention-in-this-application person etc. found out that the circular polarization of light was changed into the circular polarization of light of the circumference of reverse good, when deltan-d of the liquid crystal layer 1 was adjusted for every twist angle and a twist angle was within the limits of 0 times or more and 40 degrees or less. When the permeability of the light in the visible wavelength at the time of zero twist angle is specifically made into 100%, A twist angle the permeability of light in case the permeability of light in case a twist angle is 30 degrees is 40 degrees 88.6% 80.8%, The permeability of light in case 72.0% and the twist angle of the permeability of light in case a twist angle is 50 degrees are 60 degrees becomes 62.4%, and when permeability estimates the polarization conversion operation which changes the circular polarization of light into the circular polarization of light of the circumference of reverse, permeability falls with increase of a twist angle. For this reason, the upper limit of a twist angle obtained the conclusion that setting to about 40 degrees was appropriate from the above-mentioned result.

[0202] A twist angle is a twist angle of the arbitration of 0 times or more, and a setup of the twist angle of the transparency display 10 which changes the linearly polarized light into the linearly polarized light which intersects perpendicularly efficiently on the other hand can realize fully efficient permeability, when the wavelength of light is limited to one wavelength. However, in order to obtain high permeability in the field where visible wavelength is large, an optimum value exists in a twist angle. When a twist angle is changed, deltan-d of the liquid crystal layer 1 was specifically adjusted so that 550nm which is the main wavelength of the visible wavelength range may become the maximum permeability, and the permeability of 550nm was made into 100%, it asked for the wavelength width of face except the upper limit and minimum of wavelength from which 90% or more of permeability is obtained. In addition, count of permeability is arranged so that, as for the transparency shaft of a polarizing plate 14-15, the liquid crystal orientation which exists in the center of the direction of thickness of the liquid crystal layer 1 when light passes the polarizing plate 14 as the polarizing plate 15 as the 1st polarizing plate of the above, the liquid crystal layer 1, the 1st polarizing plate, and the 2nd polarizing plate that intersects perpendicularly may make the angle of 45 degrees, and it is asking for the permeability at that time.

[0203] Wavelength width of face (wavelength range) in case a twist angle is 0 times Consequently, 230nm, 235nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 10 degrees is 20 degrees 240nm, 245nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 30 degrees is 40 degrees 250nm, 255nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 50 degrees is 60 degrees 265nm, 280nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 70 degrees is 80 degrees 310nm, Wavelength width of face in case 255nm and the twist angle of wavelength width of face in case 305nm and the twist angle of wavelength width of face in case 330nm and the twist angle of wavelength width of face in case a twist angle is 90 degrees are 100 degrees are 110 degrees are 120 degrees was set to 210nm.

[0204] The above examination showed that realized by wavelength width of face (wavelength range) with large permeability with a twist angle high within the limits of 60 degrees or more and 110 degrees or less, a good polarization conversion operation was realized, and a good display was attained. Therefore, the

twist angle of the liquid crystal of the transparency display 10 which fulfills the 2nd condition of the above is limited within the limits of 0 times or more and 40 degrees or less, or within the limits of 60 degrees or more and 110 degrees or less from the polarization conversion operation over the above circular polarization of light, and the polarization conversion operation over the linearly polarized light.

[0205] It became clear that the twist angle within the limits of 0 times or more and 40 degrees or less or within the limits of 60 degrees or more and 110 degrees or less gives a good display to the transparency display 10 as mentioned above at the reflective display 9 within the limits of 0 times or more and 100 degrees or less. That is, as a twist angle for obtaining a good display by both the reflective display 9 and the transparency display 10 as an example of the gestalt of operation of this invention, within the limits of 0 times or more and 40 degrees or less or within the limits of 60 degrees or more and 100 degrees or less is suitable.

[0206] In addition, in the example shown below, it sets for an example (an example 2 - an example 9, and example 11) with the equal twist angle of the liquid crystal layer 1 in the reflective display 9 and the transparency display 10. The typical example for which a twist angle uses the circular polarization of light at 0 times is an example 11 (liquid crystal orientation is perpendicular orientation), and the typical example for which a twist angle uses the linearly polarized light at 0 times is an example 3 (it is adjusting so that it may become good clear display with a phase contrast compensating plate). Moreover, the typical example for which a twist angle uses the linearly polarized light near 70 degrees is an example 5 (it is adjusting so that it may become good clear display with a phase contrast compensating plate).

[0207] According to examination mentioned above, the twist angle of the liquid crystal layer 1 for both obtaining a good display by the reflective display 9 and the transparency display 10 becomes within the limits of 0 times or more and 40 degrees or less, or within the limits of 60 degrees or more and 100 degrees or less.

[0208] In the above explanation, although the magnitude of a twist angle was explained only about the forward sign, it cannot be overemphasized that the same argument is effective also about the negative sign (that to which the twist direction is twisted conversely) with the same absolute value.

[0209] When setting up a twist angle small, also in any function of the product (deltan-d) of a refractive-index difference (deltan) and liquid crystal thickness (d) or case, change of a polarization condition becomes. And in the reflective display 9, since incident light goes and comes back to the liquid crystal layer 1 and incident light passes the liquid crystal layer 1 only at once in the transparency display 10, as for the liquid crystal thickness in the transparency display 10, it is desirable to be thickly set up as compared with the liquid crystal thickness in the reflective display 9.

[0210] In addition, also in TN liquid crystal display using the usual rotatory polarization, since it will be in the condition that the rotatory polarization and change of the polarization condition by the retardation are undistinguishable and generally uses elliptically polarized light for a display when liquid crystal thickness is thin, it is needless to say that it can use for the clear display and the dark display using the polarization conversion operation which mentioned above the rotatory polarization used in the above-mentioned TN liquid crystal display. The modulation of the transmitted light reinforcement by these rotatory polarization is also included in the polarization conversion operation in this invention.

[0211] furthermore, in the above-mentioned polarization conversion operation, for change of the liquid crystal orientation to which a polarization condition may be changed As mentioned above, whether the orientation condition of liquid crystal is parallel to a substrate 4-5, or perpendicular like not only a thing but the surface passivation ferroelectric liquid crystal to control, or antiferroelectricity liquid crystal That from which only the direction of orientation changes while liquid crystal had maintained orientation bearing almost parallel to a substrate 4-5, and the thing to which orientation bearing is changed, using a pneumatic liquid crystal, changing electrode structure, and maintaining the direction of orientation of liquid crystal in a field parallel to the screen are also contained.

[0212] Moreover, in the above-mentioned liquid crystal display, installation bearing (pasting bearing) of a polarizing plate 14-15 can be set up suitably. For example, what is necessary is just to appoint

installation bearing of a polarizing plate 15 according to installation bearing of this polarizing plate 14, in order that the same polarizing plate 14 may act inevitably also to the display light which penetrates the transparency display 10, if installation bearing of a polarizing plate 14 is set up according to the reflective display 9.
[0213] As mentioned above, when liquid crystal orientation without a twist was used for a display and the reflective display 9 showed for example, a dark display, the dark display was shown similarly [the transparency display 10]. However, for example, if installation bearing of a polarizing plate 14 remains as it is and installation bearing of a polarizing plate 15 is changed 90 degrees, reversal of a display will take place by the reflective display 9 and the transparency display 10. That is, a good display is not obtained if it remains as it is. So, in order to prevent reversal of such a display, the electrode which returned installation bearing of a polarizing plate 15, or became independent respectively to the reflective display 9 and the transparency display 10 may be given, the electric drive itself may be reversed by either the reflective display 9 or the transparency display 10, and the light and darkness of a display may be made in agreement.
[0214] Next, the display principle in the reflective display 9 and the transparency display 10 in the liquid crystal display shown in drawing 4 is further explained to a detail.
[0215] First, the display principle in the reflective display 9 is explained below. In addition, in order to simplify explanation, by the following explanation, the liquid crystal orientation of the liquid crystal layer 1 shall not have the twist by reflective display 9b and transparency display 10b, without using the phase contrast compensating plate 16-17. Furthermore, respectively, when light with a wavelength of 550nm penetrates the liquid crystal layer 1 only once, reflective display 9b and transparency display 10b so that it may have quarter-wave length and 1/2 wave of phase contrast The thickness of the reflective display 9 and the transparency display 10 shall be adjusted, a liquid crystal constituent shall have a forward dielectric constant anisotropy, the liquid crystal orientation in [electrical-potential-difference] not impressing shall be parallel in general to a substrate 4-5, and, as for the orientation bearing, the include angle of 45 degrees shall be made to absorption shaft bearing of a polarizing plate 14.
[0216] In this case, the liquid crystal orientation in the reflective display 9 and the transparency display 10 in electrical-potential-difference the condition of not impressing turns into liquid crystal orientation shown in reflective display 9b and transparency display 10b, and the liquid crystal orientation in the reflective display 9 and the transparency display 10 which changed with impression of an electrical potential difference turns into liquid crystal orientation shown in reflective display 9a and transparency display 10a.
[0217] As for the refractive-index difference (deltan) of a liquid crystal constituent, and the product (deltan-d) with liquid crystal thickness (d), quarter-wave length conditions are satisfied in above-mentioned reflective display 9b. For this reason, in the case of incidence, an ambient light turns into the linearly polarized light with a polarizing plate 14, and further, when reaching the reflective film 8 by the retardation of the liquid crystal layer 1, it turns into the circular polarization of light. At this time, a travelling direction reverses incident light by the reflective film 8, and the circular polarization of light turns into the circular polarization of light which intersected perpendicularly to the polarization at the time of incidence, i.e., the circular polarization of light which right and left reversed, in order that the hand of cut of oscillating electric field may be saved and only a travelling direction may be reversed. This circular polarization of light passes the liquid crystal layer 1 of reflective display 9b again, turns into the linearly polarized light parallel to absorption shaft bearing of a polarizing plate 14, is absorbed with a polarizing plate 14 and serves as a dark display.
[0218] Moreover, as for the refractive-index difference (deltan) of a liquid crystal constituent, and the product (deltan-d) with liquid crystal thickness (d), in transparency display 10b, 1/2-wave conditions are satisfied at this time. For this reason, the liquid crystal layer 1 has the operation which changes into axial symmetry bearing of the plane of vibration of the linearly polarized light which carried out incidence to the direction of liquid crystal orientation. Therefore, it is determined that absorption shaft bearing of

the polarizing plate 15 by the side of the incidence of the light to transparency display 10b will become transparency shaft bearing of a polarizing plate 14 and a polarizing plate 15 and parallel as the light which passes a polarizing plate 14 is absorbed with a polarizing plate 14 and serves as a dark display in response to the operation which the liquid crystal layer 1 mentioned above.

[0219] Thus, when those transparency shaft bearings had been arranged so that a polarizing plate 14 and a polarizing plate 15 might make the include angle this transparency shaft bearing to parallel and whose liquid crystal orientation are 45 degrees, it turned out that both reflective display 9b and transparency display 10b become a dark display.

[0220] Next, the operation at the time of changing the orientation condition of liquid crystal from electrical-potential-difference the condition of not impressing (initial orientation condition of liquid crystal) shown in above-mentioned reflective display 9b and transparency display 10b almost perpendicularly to the screen by giving the potential difference to an electrode 6 and an electrode 7, as shown in reflective display 9a and transparency display 10a is explained below.

[0221] In this case, outgoing radiation is carried out from a polarizing plate 14, with bearing of the linearly polarized light which passed again the liquid crystal layer 1 after it reaches the reflective film 8, without a polarization condition changing, as for incident light since an ambient light turns into the linearly polarized light with a polarizing plate 14 in reflective display 9a and the liquid crystal layer 1 does not have a retardation to that linearly polarized light and a travelling direction is further reversed, and intersected perpendicularly with absorption shaft bearing of a polarizing plate 14 maintained.

[0222] Moreover, it passes through a polarizing plate 14 also in transparency display 10a, incident light's turning into the linearly polarized light, and maintaining bearing of the linearly polarized light in general with a polarizing plate 15, like reflective display 9a.

[0223] When using the polarization conversion operation by the above optical anisotropies for a display, liquid crystal is carrying out parallel orientation of the amount of this polarization conversion operation, and when the electrical potential difference is not impressed to the liquid crystal layer 1, it is determined by the product (deltan-d) of the twist angle of the orientation of the liquid crystal layer 1, and a liquid crystal thickness (d) and the refractive-index difference (deltan) of a liquid crystal constituent. For this reason, like this invention, in the liquid crystal display which uses the transmitted light and the reflected light for a display, it is effective that the transparency display 10 has liquid crystal thickness thicker than the reflective display 9 in order to reconcile the lightness and the contrast ratio of a display by both the reflective display 9 and the transparency display 10. In addition, twist angles may differ respectively by the reflective display 9 and the transparency display 10.

[0224] Moreover, when the above-mentioned liquid crystal display is equipped with the phase contrast compensating plate 16-17, to the light of two or more wavelength of a light region, sufficient lightness and a sufficient contrast ratio can be secured, consequently a still better display can be realized.

[0225] Moreover, even if the liquid crystal constituent and orientation of the liquid crystal layer 1 are the same as that of the above-mentioned explanation, it is possible to reverse change of the above-mentioned display according to an operation of the phase contrast compensating plate 16-17. If it is got blocked, for example, a quarter-wave length plate is used as a phase contrast compensating plate 16-17, in reflective display 9b An ambient light becomes the liquid crystal layer 1 with the phase contrast compensating plate 16 at the circular polarization of light in the case of incidence, and further according to the polarization conversion operation by the optical anisotropy of the liquid crystal layer 1 When reaching the reflective film 8, after it becomes the linearly polarized light and a travelling direction is reversed with the reflective film 8, Since it is again changed into the transparency component of a polarizing plate 14 and outgoing radiation is carried out from a polarizing plate 14, it becomes clear display, and as shown in reflective display 9a, when liquid crystal orientation changes, since an ambient light reaches the reflective film 8 with the circular polarization of light, it becomes a dark display.

[0226] Moreover, although the above-mentioned explanation explained the case where a display changed from a dark display to clear display, with the increment in the potential difference of an electrode 6 and

an electrode 7, change of this display can be reversed by making negative the dielectric constant anisotropy of the liquid crystal constituent used for the liquid crystal layer 1, and making the initial orientation condition of liquid crystal into perpendicular orientation, as it is not limited to this and mentioned above.

[0227] Here, in setting the initial orientation condition of liquid crystal as perpendicular orientation, it equips the polarization conversion operation of initial orientation with the technical feature of not being greatly influenced by the production precision of liquid crystal thickness. Therefore, it can become the high means of mass-production nature to assign an initial orientation condition to a black display so that the black display which influences display grace greatly may be stabilized, in order to employ this description efficiently. In order to realize especially this, after the polarization conversion operation of the liquid crystal layer 1 which carried out orientation perpendicularly has disappeared mostly, it is necessary to give an indication black, and a good circular polarization of light-ized operation is required for the phase contrast compensating plate 16. That is, it is important to have a configuration which serves as the circular polarization of light on the largest possible wavelength as a phase contrast compensating plate 16.

[0228] Moreover, the transparency display 10 serves as a dark display in the liquid crystal orientation shown in clear display and transparency display 10a in the liquid crystal orientation shown in transparency display 10b, when being arranged so that it may have absorption shaft bearing where it is arranged in so that it may have lagging-axis bearing where the phase contrast compensating plate 17 and the phase contrast compensating plate 16 intersect perpendicularly, and a polarizing plate 14 and a polarizing plate 15 intersect perpendicularly mutually.

[0229] Even if the orientation of the liquid crystal layer 1 is which [of parallel orientation and perpendicular orientation] case, when it changes liquid crystal thickness by the reflective display 9 and the transparency display 10, in the liquid crystal display concerning this invention by the reflective display 9 and the transparency display 10 In order to reconcile lightness and a contrast ratio It displays, when the light which carried out incidence through the liquid crystal layer 1 from the screen side carries out outgoing radiation to a screen side through the liquid crystal layer 1 in the reflective display 9 again, as mentioned above. In the transparency display 10 When the light which carried out incidence from the tooth-back side (back light 13 side) passes the liquid crystal layer 1 only at once, and carries out outgoing radiation to a screen side and it displays It is effective that the liquid crystal thickness in the transparency display 10 is set up more thickly than the liquid crystal thickness in the reflective display 9, and satisfies the above-mentioned conditions as the result.

[0230] Although a concrete example and the example of a comparison are given and explained with reference to drawing 4 - drawing 8 about the liquid crystal display which uses change of the polarization condition by polarization conversion operation of the liquid crystal layer 1 for a display among the liquid crystal displays concerning the gestalt of this operation hereafter using a polarizing plate 14-15, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0231] [An example 2 - example 4] In the example 2 - the example 4, the liquid crystal cell for liquid crystal impregnation which has the liquid crystal thickness (d) whose transparency display 10 is 7.5 micrometers, and whose reflective display 9 is 4.5 micrometers was produced by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach. That is, also in the example 2 - the example 4, by sensitization resin's not remaining in the transparency display 10, but carrying out pattern formation of the insulator layer 11 so that it may be formed in the thickness this whose sensitization resin is 3 micrometers in the reflective display 9, in the transparency display 10, liquid crystal thickness set up rather than the reflective display 9 so that it might become thick. However, in the example 2 - the example 4, as shown in drawing 4 , the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that an electrical potential difference might be separately impressed

to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0232] Furthermore, in the example 2 - the example 4, the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal impregnation is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a forward dielectric constant anisotropy by the vacuum pouring-in method.
[0233] And the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the liquid crystal cell obtained by doing in this way, and the liquid crystal display was produced. At this time, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 17 from examples 2-4, the phase contrast compensating plate of one sheet constituted the phase contrast compensating plate 16 from the example 3, and the phase contrast compensating plate of two sheets constituted it from the example 2-4. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0234] Moreover, in the example 2, liquid crystal orientation was made into homogeneous orientation, and used NB (Nor Marie Black) mode for the display. In the example 3, liquid crystal orientation was made into homogeneous orientation, and used NW (Nor Marie White) mode for the display. And in the example 4, what mixed these (NB mode is used for a reflective display and NW mode is used for a transparency display) was used.
[0235] However, in the above-mentioned example 2 - the example 4, when not impressing an electrical potential difference, while using the orientation film of an parallel stacking tendency for the orientation film 2-3, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed, so that liquid crystal might carry out orientation in parallel with the screen.
[0236] As it is indicated in drawing 5 as a rubbing crossed axes angle, it sets to the liquid crystal cell for liquid crystal impregnation here. It is based on the rubbing bearing X which is orientation processing bearing of the orientation film 2 (namely, orientation film 2 by the side of a substrate 4) in the electrode substrate which is an observer side substrate among the electrode substrates of the pair which pinches the liquid crystal layer 1. It is defined as the include angle which measured the rubbing bearing Y which is orientation processing bearing of the orientation film 3 (namely, orientation film 3 by the side of a substrate 5) in the electrode substrate of another side to the circumference of an anti-clock.
[0237] The orientation condition of the liquid crystal molecule in the liquid crystal layer 1 currently pinched with the orientation film 2-3 by which orientation processing was carried out is determined by the stacking tendency of the orientation film 2-3, the addition of the chiral additive which gives the twist of a proper to liquid crystal, and the rubbing crossed axes angle when electric field, a field, etc. do not exist.
[0238] When a rubbing crossed axes angle is 180 degrees, orientation of the liquid crystal constituent with which the chiral additive is not mixed is carried out without twisting. Moreover, orientation of the liquid crystal layer 1 is carried out without twisting, and when a chiral additive carries out induction of the twist of a left twist to liquid crystal, if a certain constant rate is exceeded, twist orientation (180-degree left twist orientation) of it will be carried out to counterclockwise twining 180 degrees, until the addition of a chiral additive reaches a certain constant rate. And if the addition of the above-mentioned chiral additive is increased further, 180 twists of only an integral multiple will be realized according to the increment in a chiral additive.
[0239] Therefore, orientation bearing of the liquid crystal on the orientation film 3 realized with the rubbing crossed axes angle (180 degrees) mentioned above in the gestalt of this operation When you increase the quantity of a chiral additive x times in making into x times rubbing bearing X of the orientation film 2 arranged on the electrode substrate of the liquid crystal layer 1 top and not adding a

chiral additive, and you are twisting on the left 180 degrees between up-and-down electrode substrates, suppose that it is expressed as whenever (180+x).
[0240] In addition, it is the so-called parallel orientation film to which the orientation film 2-3 carries out orientation of the liquid crystal in parallel to an orientation film surface in such orientation processing. When the dielectric constant anisotropy in which the chiral additive is not mixed uses a forward pneumatic liquid crystal When not impressing an electrical potential difference, a liquid crystal molecule is almost parallel to the electrode substrate of the upper and lower sides whose liquid crystal layer 1 is pinched, and takes an orientation (namely, homogeneous orientation) condition without a twist, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.
[0241] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in each liquid crystal display obtained in the example 2 - the example 4, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 1 using the criteria of common bearing in each example.
[0242] In addition, the optical arrangement shown in Table 1 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0243] Moreover, although orientation bearing (orientation bearing of a liquid crystal molecule major axis) of the liquid crystal layer 1 whole at the time of no electrical-potential-difference impressing has been indicated since the liquid crystal layer 1 has taken the orientation which is not twisted, this orientation bearing is bearing of the orientation processing performed to the orientation film 2 by the side of a substrate 4.
[0244] In addition, each bearing expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation (namely, product of the refractive-index difference within the field of a phase contrast compensating plate and thickness) of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0245]
[Table 1]

[0246] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 2, the example 3, and the example 4 is respectively shown in drawing 6 , drawing 7 , and drawing 8 . In addition, each of these display properties is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage in each above-mentioned drawing, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, make into 100% of permeability the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.
[0247] In drawing 6 , a curve 211 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 2, and a curve 212 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 2.
[0248] As shown in drawing 6 , in the example 2, both a reflection factor and permeability are rising with the rise of applied voltage in the section whose applied voltage is 1V-2V. Moreover, both the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V, and the permeability of the transparency display 10 were 40%.
[0249] Moreover, in drawing 7 , a curve 221 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3, and a curve 222 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3.
[0250] As shown in drawing 7 , in the example 3, both a reflection factor and permeability are decreasing with the rise of applied voltage in the section whose applied voltage is 1V-2V. Moreover, both the reflection factor of the reflective display 9 in case applied voltage is 1V, and the permeability of the

transparency display 10 were 40%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 2V was 2% 3%.

[0251] Moreover, in drawing 8 , a curve 231 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4, and a curve 232 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4.

[0252] As shown in drawing 8 , while a reflection factor rises with the rise of applied voltage, in the example 4, permeability is decreasing in the section whose applied voltage is 1V-2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 40% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V was 2% 40%.

[0253] As mentioned above, all, a reflection factor changes to a permeability list with the change of applied voltage to this liquid crystal display, and both the reflective display and the transparency display were possible for the liquid crystal display obtained in the above-mentioned example 2 - the example 4.

[0254] Furthermore, when visual observation is carried out, it sets in an example 2 and the example 3. By impressing the same electrical potential difference to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 Since it displayed with the electrode 6 and the electrode 7 by keeping the same the electrical potential difference applied to the liquid crystal layer 1 by the reflective display 9 and the transparency display 10, change of light and darkness is the same at the reflective display 9 and the transparency display 10, and it checked that reversal of the light and darkness of a display did not arise. Moreover, even if it is in the middle of observation and changed the reinforcement of an ambient light in the case of this display, change of the contents of a display was not seen. That is, when the reflective display 9 was a dark display, the transparency display 10 also became a dark display, and when the reflective display 9 was clear display, the transparency display 10 also became clear display. For this reason, reversal of a display was not produced when it drove at the reflective display 9 and the transparency display 10 using the same electrode 7 like a publication to said drawing 1 .

[0255] On the other hand, in the example 4, when an electrical potential difference was impressed like an example 2 and an example 3 (i.e., when the electrical potential difference of 1V is impressed), the transparency display 10 became clear display and the reflective display 9 became a dark display. Moreover, when the electrical potential difference of 2V was impressed, the transparency display 10 became a dark display and the reflective display 9 became clear display. For this reason, the light and darkness of a display were reversed by the transparency display 10 and the reflective display 9. When it displayed in the weak environment of an ambient light, and the transparency display 10 was mainly being observed for this reversal, the ambient light was strengthened and the reflective display was performed, the light and darkness of a display were reversed and difficulty was produced in the check of the contents of a display. As shown in an example 4, when the same electrical potential difference was impressed from this to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 and it was the mixed mode of NB and NW, reversal of a display was large and the thing of the reflective display 9 and the transparency display 10 for which visibility is worsened was checked.

[0256] So that the transparency display 10 also serves as clear display in an example 4 on the other hand at coincidence when the reflective display 9 is clear display, and the transparency display 10 may also become coincidence with a dark display, when the reflective display 9 is a dark display A different electrical potential difference to the electrode 7 in the reflective display 9 and the electrode 7 in the transparency display 10 is impressed. that is, when impressing the electrical potential difference (1V) this reflective display 9 indicates a dark display to be to the reflective display 9 with an electrode 6-7

(orientation device) When impressing the electrical potential difference (2V) from which this transparency display 10 serves as a dark display to the transparency display 10 and impressing the electrical potential difference (2V) from which this reflective display 9 serves as clear display at the reflective display 9 By impressing the electrical potential difference (1V) from which this transparency display 10 serves as clear display to the transparency display 10, reversal of the light and darkness of a display was solved and the same good display condition as an example 2 and an example 3 was acquired.
[0257] The above thing shows that each liquid crystal display of the above-mentioned example 2 - an example 4 can realize the display which could make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10, and was excellent in visibility while each was [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9. Moreover, it turns out that each of each liquid crystal displays of the above-mentioned example 2 - an example 4 can raise display grace further, and can perform a good display from the contrast ratio in the transparency display 10 exceeding the contrast ratio in the reflective display 9.
[0258] Next, although a concrete example and the example of a comparison are given and explained with reference to drawing 9 and drawing 10 about the liquid crystal display which uses a polarization conversion operation of the liquid crystal layer 1 by the twist orientation of the liquid crystal layer 1 for a display among the liquid crystal displays concerning the gestalt of this operation, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0259] [Example 5] In this example, the liquid crystal cell for liquid crystal impregnation which has the liquid crystal thickness whose transparency display 10 is 7.5 micrometers, and whose reflective display 9 is 4.5 micrometers was produced by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach. That is, also in this example, by sensitization resin's not remaining in the transparency display 10, but carrying out pattern formation of the insulator layer 11 so that it may be formed in the thickness this whose sensitization resin is 3 micrometers in the reflective display 9, in the transparency display 10, liquid crystal thickness set up rather than the reflective display 9 so that it might become thick.
[0260] However, in this example, like examples 2-4, as shown in drawing 4 , the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that an electrical potential difference might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0261] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0262] At this example, it is the twist orientation (the liquid crystal display was produced so that the twist angle (twist angle) of the orientation of liquid crystal might become 70 degrees.) of the liquid crystal layer 1. Specifically, orientation processing was performed using the orientation film of an parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation

processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0263] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 2 using the criteria of common bearing.
[0264] [Example 6] This example as well as an example 5 produced the liquid crystal cell for liquid crystal impregnation which has the liquid crystal thickness (d) whose transparency display 10 is 7.5 micrometers, and whose reflective display 9 is 4.5 micrometers by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach. Moreover, as shown in drawing 4 , the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that an electrical potential difference might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0265] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, in this example, the phase contrast compensating plate of one sheet was respectively used for the phase contrast compensating plate 16 and the phase contrast compensating plate 17. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0266] In this example, the liquid crystal display was produced so that the twist orientation (twist angle of the orientation of liquid crystal (twist angle)) of the liquid crystal layer 1 might become 90 degrees. Specifically, orientation processing was performed using the orientation film of an parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 270 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 90 degrees. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0267] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 2 using the criteria of common bearing.
[0268] In addition, the optical arrangement shown in Table 2 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0269] Moreover, orientation bearing (orientation bearing of a liquid crystal molecule major axis) of the

liquid crystal layer 1 is equal to bearing of the rubbing processing performed to the orientation film 2 by the side of a substrate 4 in a substrate 4 side, and equal to bearing of the rubbing processing performed to the orientation film 3 by the side of a substrate 5 in a substrate 5 side. However, when orientation bearing of the liquid crystal which touches the orientation film 2 is pursued to the orientation film 3 side, 90 left twist orientation is carried out. Thus, when liquid crystal orientation is pursued and rubbing processing bearing to the orientation film 2 is considered to be orientation bearing by the side of a substrate 4 (for it to be hereafter written as substrate 4 orientation bearing), rubbing bearing of the orientation film 3 turns into bearing which reversed bearing which pursued the orientation of liquid crystal according to the twist 180 degrees. Hereafter, orientation bearing by the side of a substrate 5 (it is hereafter written as substrate 5 orientation bearing) is defined as liquid crystal orientation on the substrate 5 which pursued the orientation of liquid crystal according to the twist from substrate 4 orientation bearing.

[0270] In addition, each bearing in Table 2 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.

[0271]

[Table 2]

[0272] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 5 and the example 6 is respectively shown in drawing 9 and drawing 10 . In addition, each of these display properties is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage in each above-mentioned drawing, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, make into 100% of permeability the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.

[0273] In drawing 9 , a curve 241 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5, and a curve 242 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display

obtained in the example 5.
[0274] As shown in drawing 9 , in the example 5, both a reflection factor and permeability are rising [applied voltage] with the rise of applied voltage in the section beyond 1.2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 4V was 40% 41%.
[0275] Moreover, in drawing 10 , a curve 251 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 6, and a curve 252 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 6.
[0276] As shown in drawing 10 , both a reflection factor and permeability are rising [applied voltage] with the rise of applied voltage in the example 6 as well as an example 5 in the section beyond 1.2V. Moreover, in the example 6, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 4V was 37% 35%.
[0277] As mentioned above, all, a reflection factor changes to a permeability list with the change of applied voltage to this liquid crystal display, and both the reflective display and the transparency display were possible for the liquid crystal display obtained in the above-mentioned example 5 and the example 6.
[0278] Furthermore, when visual observation is carried out, it sets in an example 5 and the example 6. By impressing the same electrical potential difference to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 When displaying with the electrode 6 and the electrode 7 by keeping the same the electrical potential difference applied to the liquid crystal layer 1 by the reflective display 9 and the transparency display 10, change of light and darkness is the same at the reflective display 9 and the transparency display 10, and it checked that reversal of the light and darkness of a display did not arise. Moreover, even if it is in the middle of observation and changed the reinforcement of an ambient light in the case of this display, change of the contents of a display was not seen. That is, when the reflective display 9 was a dark display, the transparency display 10 also became a dark display, and when the reflective display 9 was clear display, the transparency display 10 also became clear display. For this reason, in the above-mentioned example 5 and the example 6, when it drove at the reflective display 9 and the transparency display 10 using the same electrode 7 like a publication to said drawing 1 , reversal of a display was not produced.
[0279] Therefore, all, each liquid crystal display of the above-mentioned example 5 and an example 6 can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while it is [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9, and it can realize the display excellent in visibility. Moreover, from the contrast ratio in the transparency display 10 exceeding the contrast ratio in the reflective display 9, each of each liquid crystal displays of the above-mentioned example 5 and an example 6 can raise display grace further, and can realize a good display.
[0280] Moreover, an example 6 has little number of sheets of the phase contrast compensating plate used as compared with an example 5, and the liquid crystal display which is excellent in visibility and uses for a display both the reflected lights and transmitted lights in which a high resolution color display (color display) is possible can be offered more cheaply.
[0281] With the gestalt of the above operation, by changing liquid crystal thickness by the reflective display and the transparency display explained the liquid crystal display which performs a good transparency display in a good reflective display list. The following explanation explains the liquid crystal

display which sets up and performs a good transparency display in a good reflective display list so that the liquid crystal thickness in a reflective display and the liquid crystal thickness in a transparency display may become equal.

[0282] [Gestalt 3 of operation] With the gestalt of this operation, when the liquid crystal thickness in a reflective display and the liquid crystal thickness in a transparency display are equal, the liquid crystal display which realizes a good transparency display is explained to a good reflective display list by changing the electrical potential difference which carries out a seal of approval by the reflective display and the transparency display, and changing liquid crystal orientation by the reflective display and the transparency display.

[0283] With the gestalt of this operation, the polarizing plate 14-15 of a publication is used for the gestalt 2 of said operation, the case where it sets up in the liquid crystal display which uses the retardation of the liquid crystal layer 1 for a display so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10 is mentioned as an example, and such a liquid crystal display is explained using a concrete example and the example of a comparison with reference to drawing 4 and drawing 11 - drawing 16 . However, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0284] In addition, the same number is given to the component which has the function as the gestalt 1 of said operation, and the gestalt 2 of operation of explanation same for convenience, and the explanation is omitted. Moreover, since it is the same as that of the gestalt 2 of said operation except being set up about the concrete whole configuration of the liquid crystal display concerning the gestalt of this operation so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10, the explanation is omitted here.

[0285] What is necessary is just to form an electrode 7 directly on a substrate 5, without forming the insulator layer 11 formed on said substrate 5, in order to set up so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10 as shown in the gestalt of this operation.

[0286] [Example 7] As the insulator layer 11 which consists of sensitization resin which has insulation is not formed on a substrate 5 in an example 1 in this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 4.5-micrometer liquid crystal thickness (d).

[0287] And the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal impregnation is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a forward dielectric constant anisotropy by the vacuum pouring-in method.

[0288] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).

[0289] In this example, while using the liquid crystal layer in which liquid crystal carries out orientation to parallel (parallel to the screen) and which has not carried out twist orientation to the liquid crystal layer 1 to the substrate 4-5, the birefringence mode in which the retardation of the liquid crystal layer 1

was used for a display was used as a liquid crystal display method.
[0290] Moreover, the retardation suitable for a reflective display was used for the transparency display 10 in this example. Here, although the reflective display 9 is set up like the reflective display 9 of the example 2 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the reflective display 9, and it is set up by the transparency display 10, and differ in the example 2. For this reason, in this example, in an example 2, again, the optical design was performed and optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that the dark display of the transparency display 10 might be good.
[0291] Moreover, in this example, while using the orientation film of an parallel stacking tendency for the orientation film 2-3 like said example 2 so that liquid crystal might carry out orientation in parallel with the screen when not impressing an electrical potential difference, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed. In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.
[0292] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 3 using the criteria of common bearing.
[0293] [Example 3 of a comparison] Here, the example of a comparison of the above-mentioned example 7 is shown. In this example 3 of a comparison, while the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 in the liquid crystal display shown in an example 7, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having set optical arrangement of the phase contrast compensating plate 16-17 as polarizing plate 14 and 15 lists so that the clear display of the transparency display 10 might become good. Pasting bearing of the above-mentioned phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0294] Moreover, also in this example of a comparison, while using the orientation film of an parallel stacking tendency for the orientation film 2-3 like said example 7 so that liquid crystal might carry out orientation in parallel with the screen when not impressing an electrical potential difference, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed. In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.
[0295] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of a comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 3 using the criteria of common bearing.
[0296] [Example 8] In the liquid crystal display shown in an example 7 by this example The liquid crystal thickness (d) in the reflective display 9 and the liquid crystal thickness (d) in the transparency display 10 are both 7.5 micrometers. The retardation suitable for a transparency display was used for the reflective display 9, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having set optical arrangement of the phase contrast compensating plate

16-17 as polarizing plate 14 and 15 lists so that a reflective display might be good.
[0297] As the insulator layer 11 which consists of sensitization resin which has insulation is not more specifically formed on a substrate 5 in an example 1 by this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 7.5-micrometer liquid crystal thickness (d).
[0298] And the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal impregnation is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a forward dielectric constant anisotropy by the vacuum pouring-in method.
[0299] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0300] In this example, while using the liquid crystal layer in which liquid crystal carries out orientation to parallel (parallel to the screen) and which has not carried out twist orientation to the liquid crystal layer 1 to the substrate 4-5, the birefringence mode in which the retardation of the liquid crystal layer 1 was used for a display was used as a liquid crystal display method.
[0301] Moreover, the retardation suitable for a transparency display was used for the reflective display 9 in this example. Here, although the transparency display 10 is set up like the transparency display 10 of the example 2 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the transparency display 10, and it is set up by the reflective display 9, and differ in the example 2. For this reason, in this example, in an example 2, again, the optical design was performed and optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that a reflective display might be good.
[0302] Moreover, in this example, while using the orientation film of an parallel stacking tendency for the orientation film 2-3 like said example 2 so that liquid crystal might carry out orientation in parallel with the screen when not impressing an electrical potential difference, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed. In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.
[0303] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 3 using the criteria of common bearing.
[0304] In addition, the optical arrangement shown in Table 3 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned

phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0305] Moreover, although orientation bearing (orientation bearing of a liquid crystal molecule major axis) of the liquid crystal layer 1 whole at the time of no electrical-potential-difference impressing has been indicated since the liquid crystal layer 1 has taken the orientation which is not twisted, this orientation bearing is bearing of the rubbing processing performed to the orientation film 2 by the side of a substrate 4.
[0306] In addition, each bearing expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0307]
[Table 3]

[0308] [Example 4 of a comparison] In the liquid crystal display shown in an example 7 in this example of a comparison Liquid crystal carries out orientation to the liquid crystal layer 1 to a substrate 4-5 at parallel (parallel to the screen). And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.
[0309] As the insulator layer 11 which consists of sensitization resin which has insulation is not more specifically formed on a substrate 5 in an example 1 in this example of a comparison and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 4.5-micrometer liquid crystal thickness (d).
[0310] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were

stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example of a comparison. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).

[0311] Furthermore, in this example of a comparison, orientation processing was performed by performing rubbing processing using the orientation film of an parallel stacking tendency, so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. In addition, the above-mentioned chiral additive is adjusting the addition so that the above-mentioned twist angle may be acquired. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.

[0312] Moreover, in this example of a comparison, the refractive-index difference (deltan) of the liquid crystal constituent suitable for a reflective display and the product (deltan-d) with liquid crystal thickness (d) were used for the transparency display 10. Here, although the reflective display 9 is set up like the reflective display 9 of the example 5 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the reflective display 9, and it is set up by the transparency display 10, and differ in the example 5. For this reason, in this example of a comparison, in an example 5, again, the optical design was performed and optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example of a comparison, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that the dark display of the transparency display 10 might be good.

[0313] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of a comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 4 using the criteria of common bearing.

[0314] [Example 5 of a comparison] In this example of a comparison, the liquid crystal display shown in the example 4 of a comparison and the liquid crystal display designed similarly were produced in the liquid crystal display shown in the example 4 of a comparison except having set the phase contrast compensating plate 16 and optical arrangement of 17 as polarizing plate 14 and 15 lists so that the clear display of the transparency display 10 might become good. Namely, in this example of a comparison, in the liquid crystal display shown in an example 7, optical arrangement of the phase contrast compensating plate 16-17 is set as polarizing plate 14 and 15 lists so that the clear display of the transparency display 10 may become good. And liquid crystal carries out orientation to the liquid crystal layer 1 to a substrate 4-5 at parallel (parallel to the screen). And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.

[0315] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in

the liquid crystal display obtained in this example of a comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 4 using the criteria of common bearing.
[0316] [Example 9] In the liquid crystal display shown in an example 8 by this example While the phase contrast compensating plate 16 is constituted from a phase contrast compensating plate of two sheets, the phase contrast compensating plate 17 is constituted from a phase contrast compensating plate of one sheet. Liquid crystal carries out orientation to the liquid crystal layer 1 to a substrate 4-5 at parallel (parallel to the screen). And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 8 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.
[0317] As the insulator layer 11 which consists of sensitization resin which has insulation is not more specifically formed on a substrate 5 in an example 1 by this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 7.5-micrometer liquid crystal thickness (d).
[0318] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0319] And in this example, the liquid crystal display was produced so that the twist orientation (twist angle of the orientation of liquid crystal (twist angle)) of the liquid crystal layer 1 might become 70 degrees. Specifically, orientation processing was performed using the orientation film of an parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when the refractive-index difference (deltan) of a liquid crystal constituent introduced the liquid crystal constituent which has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. In addition, the above-mentioned chiral additive is adjusting the addition so that the above-mentioned twist angle may be acquired. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0320] Moreover, in this example, the refractive-index difference (deltan) of the liquid crystal constituent suitable for a transparency display and the product (deltan-d) of liquid crystal thickness (d) were used for the reflective display 9. Here, although the transparency display 10 is set up like the transparency display 10 of the example 5 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the transparency display 10, and it is set up by the reflective display 9, and differ in the example 5. For this reason, in this example, in an example 5, again, the optical design was performed and

optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that a reflective display might be good.
[0321] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 4 using the criteria of common bearing.
[0322] In addition, the optical arrangement shown in Table 4 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each bearing in Table 4 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0323]
[Table 4]

[0324] As mentioned above, in the liquid crystal display concerning the example 7 and the examples 3-5 of a comparison which have 4.5-micrometer liquid crystal thickness (d), liquid crystal thickness is set up so that it may be suitable for a reflective display. For this reason, in the above-mentioned example 7 and the examples 3-5 of a comparison, optical arrangement with the polarizing plate 14 and the phase contrast compensating plate 16 only related to a reflective display is set up so that it may be suitable for a reflective display. On the other hand, the transparency display 10 is set as the liquid crystal thickness in which the liquid crystal thickness differs from the liquid crystal thickness of the transparency display 10 of the liquid crystal display in each example of the gestalt 2 of said operation.

For this reason, in the above-mentioned example 7 and the examples 3-5 of a comparison, it combined with the optical property of the transparency display 10 of each liquid crystal display, and optical arrangement of the phase contrast compensating plate 17 and a polarizing plate 15 was set up. That is, in the example 7 and the example 4 of a comparison, the liquid crystal display which can realize a good dark display was produced, and the liquid crystal display which can realize good clear display was produced in the example 3 of a comparison, and the example 5 of a comparison.
[0325] On the other hand, in the liquid crystal display concerning the example 8 and example 9 which have 7.5-micrometer liquid crystal thickness (d), liquid crystal thickness is set up so that it may be suitable for a transparency display. For this reason, in the above-mentioned example 8 and the example 9, optical arrangement of the polarizing plate 14 related to a transparency display, the phase contrast compensating plate 16, the phase contrast compensating plate 17, and a polarizing plate 15 is set up so that it may be suitable for a transparency display. Therefore, a display property is determined by optical arrangement of the polarizing plate 14 with which the reflective display 9 was set up to compensate for the transparency display, and the phase contrast compensating plate 16 in the above-mentioned example 8 and the example 9.
[0326] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 7, the example 3 of a comparison, the example 8, the example 4 of a comparison, the example 5 of a comparison, and the example 9 is respectively shown in drawing 11 , drawing 12 , drawing 13 , drawing 14 , and drawing 15 . In addition, each measures these display properties using a microscope like an example 1, an axis of abscissa shows the actual value of applied voltage in each above-mentioned drawing, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, make into 100% of permeability the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.
[0327] In drawing 11 , a curve 261 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 7, and a curve 262 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 7.
[0328] In the example 7, as shown in drawing 11 , while permeability rises with the rise of applied voltage, a reflection factor rises with the rise of applied voltage in the section whose applied voltage is 1V-2V, and it is decreasing with the rise of applied voltage in the section whose applied voltage is 1V-3V after it. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 40% and the transparency display 10 is 18% and the applied voltage of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 3% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V is 3V was 33% 28%.
[0329] Moreover, in drawing 12 , a curve 271 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3 of a comparison, and a curve 272 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3 of a comparison.
[0330] As shown in drawing 12 , in the example 3 of a comparison, both a reflection factor and permeability are rising with the rise of applied voltage in the section whose applied voltage is 1V-2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 18% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V was 40% 40%.

[0331] In drawing 13 , a curve 281 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 8, and a curve 282 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 8.
[0332] As shown in drawing 13 , in the section whose applied voltage is 1V-2V in the example 8 While permeability rises with the rise of applied voltage, a reflection factor After going up with the rise of applied voltage in the section whose applied voltage is 0.7V-1.2V, applied voltage once decreases with the rise of applied voltage in the section which are 1.2V-1.7V, and it is going up with the rise of applied voltage again after that in the section whose applied voltage is 1.7V-2.3V. Moreover, the reflection factor of the reflective display 9 in case 40% and the applied voltage of the reflection factor of the reflective display 9 in case as for the permeability of 24% and the transparency display 10 the reflection factor of the reflective display 9 in case applied voltage is 1V is 3% and its applied voltage is 1.2V are 1.7V was 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 2V was 39% 27%.
[0333] In drawing 14 , a curve 291 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4 of a comparison, and a curve 292 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4 of a comparison.
[0334] As shown in drawing 14 , in the example 4 of a comparison, both a reflection factor and permeability are rising with the rise of applied voltage in the section whose applied voltage is 1.2V-3V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 1% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1.2V is 3V was 16% 36%.
[0335] In drawing 15 , a curve 311 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5 of a comparison, and a curve 312 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5 of a comparison.
[0336] As shown in drawing 15 , in the example 5 of a comparison, both a reflection factor and permeability are rising with the rise of applied voltage in the section whose applied voltage is 1.2V-3V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 21% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1.2V is 3V was 35% 39%.
[0337] In drawing 16 , a curve 321 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 9, and a curve 322 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 9.
[0338] In the example 9, as shown in drawing 16 , while permeability rises with the rise of applied voltage, a reflection factor once decreases with the rise of applied voltage in the section whose applied voltage is 0.9V-1.7V, and is rising with the rise of applied voltage after it in the section whose applied voltage is 1.2V-3V. Moreover, the reflection factor of the reflective display 9 in case the permeability of 7% and the transparency display 10 is 32% and the applied voltage of the reflection factor of the reflective

display 9 in case applied voltage is 1.2V is 1.7V was 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 3V was 36% 37%.
[0339] In the liquid crystal display which uses change of the polarization condition by polarization conversion operation of the retardation of the liquid crystal layer 1, the rotatory polarization, etc. for a display using a polarizing plate 14-15 so that clearly from the above example and example of a comparison When the liquid crystal thickness of the liquid crystal layer 1 is made in agreement by the reflective display 9 and the transparency display 10, When the same electrical potential difference is impressed to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10, (when the reflective display 9 and the transparency display 10 are driven on a common electrical potential difference) As shown in an example 7 and the examples 3-5 of a comparison, at the time of impression of an electrical potential difference fully compatible by the reflective display 9 in the lightness and the contrast ratio of clear display, coexistence with the lightness of the clear display of the transparency display 10 and a contrast ratio is not enough. As shown in an example 8 and an example 9, at the time of impression of an electrical potential difference fully compatible by the transparency display 10 in the lightness and the contrast ratio of clear display, change of the lightness of the reflective display 9 and change of the lightness of the transparency display 10 are not in agreement, and it does not become a good display.
[0340] However, each liquid crystal display obtained in the example 7, the example 8, and the example 9 is what (the reflective display 9 and the transparency display 10 are driven on a different electrical potential difference) a different electrical potential difference to the electrode 7 in the reflective display 9 and the electrode 7 in the transparency display 10 is impressed for, and can be considered as a good display.
[0341] That is, each liquid crystal display of the above-mentioned example 7 - an example 9 By impressing the electrical potential difference from which all differ to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 While it is [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9, the light and darkness of a display can be made in agreement by the reflective display 9 and the transparency display 10, and it turns out that the display excellent in visibility is realizable.
[0342] In the liquid crystal display which uses a polarization conversion operation of the retardation of the liquid crystal layer 1, the rotatory polarization, etc. for a display using a polarizing plate 14-15 as a result of comparing the gestalt of this operation with the gestalt 2 of said operation In order to reconcile the lightness and the contrast ratio of clear display by both the reflective display 9 and the transparency display 10, it turns out that it is effective to set up more greatly than the thickness of the liquid crystal layer 1 in the reflective display 9 the thickness of the liquid crystal layer 1 in the transparency display 10.
[0343] In addition, although the liquid crystal orientation in the condition of not impressing the electrical potential difference showed the parallel thing to the direction of a flat surface of the screen as liquid crystal display mode in each example in the gestalt of this operation, and the gestalt 2 of said operation It cannot be overemphasized by using the liquid crystal ingredient of a different property from the liquid crystal ingredient illustrated in each above-mentioned example, or using the orientation film of a different property from the illustrated orientation film that perpendicular orientation mode, hybrid orientation mode, etc. can be used.
[0344] Furthermore, even if liquid crystal display mode is which the mode in which the retardation or rotatory polarization of the liquid crystal layer 1 was used, liquid crystal thickness influences an optical property and it cannot be overemphasized that a good optical property realizes all the things for which the one where the liquid crystal thickness in the reflective display 9 is thinner than the liquid crystal thickness in the transparency display 10 is suitable by this invention.
[0345] Moreover, an example 4 and an example 7 - an example 9 are giving the electrical potential

difference in which the reflective display 9 and the transparency display 10 change with electrodes 6-7 (orientation device), and it turns out that it becomes possible to display good. In this case, it becomes possible in an example 4 and the example 7 to indicate the transparency display 10 good by fully impressing an electrical potential difference to the transparency display 10. Moreover, a good display is attained when an example 8 and an example 9 all adjust the electrical potential difference of the reflective display 9. Therefore, it turns out that a good display is realizable by producing a liquid crystal cell beforehand so that an electrical potential difference can be changed into the gestalt list of this operation by the reflective display 9 and the transparency display 10 besides the approach of changing liquid crystal thickness by the reflective display 9 and the transparency display 10 according to the gestalt 2 of said operation.

[0346] [Gestalt 4 of operation] With the gestalt of this operation, by changing orientation processing bearing on the substrate which determines liquid crystal orientation (rubbing bearing), i.e., orientation processing bearing of the orientation film established in each electrode substrate, by the reflective display and the transparency display, and changing liquid crystal orientation by the reflective display and the transparency display explains the liquid crystal display which realizes a good transparency display to a good reflective display list.

[0347] With the gestalt of this operation, in order to carry out orientation of the liquid crystal layer uniformly, the so-called rubbing method is used. In order to change orientation processing bearing of the orientation film established in each electrode substrate by the reflective display and the transparency display with the gestalt of this operation, it is possible to realize at least two kinds of liquid crystal orientation by covering an orientation film front face by a photoresist etc. on the occasion of rubbing processing of the orientation film. According to this approach, it becomes possible to be able to realize liquid crystal orientation suitable for a reflective display, and liquid crystal orientation suitable for a transparency display to coincidence, consequently to realize a good transparency display in a good reflective display list.

[0348] Although the liquid crystal display concerning the gestalt of this operation is hereafter explained more to a detail, the same number is given to the component which has the function as the gestalt 3 of the gestalt 1 of said operation - operation of explanation same for convenience, and the explanation is omitted.

[0349] First, orientation down stream processing of the substrate (electrode substrate 40) used for the liquid crystal display concerning the gestalt of this operation is explained using drawing 17 and drawing 18 (a) - (e).

[0350] First, as shown in drawing 18 (a), an orientation film ingredient is applied to the contact surface with the liquid crystal layer 1 in the substrate 41 (equivalent to the substrate 4 after electrode 6 formation, or the substrate 5 after electrode 7 formation) which constitutes a liquid crystal cell (S1). Prebaking (S2) and curing (S3) are performed, and the orientation film 42 (equivalent to the orientation film 2 or the orientation film 3) is formed in the contact surface with the liquid crystal layer 1 in the above-mentioned substrate 41.

[0351] Subsequently, orientation processing of the electrode substrate 40 which equipped the interface with the liquid crystal layer 1 on the above-mentioned substrate 41 with the orientation film 42 is performed by carrying out rubbing processing of the above-mentioned orientation film 42. Under the present circumstances, with the gestalt of this operation, first, as shown in drawing 18 (b), the screen by the resist 43 for rubbing processing screens is performed so that rubbing processing may be performed partially. In this case, UV mask exposure (S6), development (S7), and curing (S8) are performed, and rubbing processing is performed to orientation processing field 42a of the above 1st after that so that the resist ingredient for rubbing processing screens may be applied and some above-mentioned orientation film 42 (1st orientation processing field 42a) may be first exposed after (S4) and prebaking (S5) on the above-mentioned orientation film 42 (S9). Subsequently, after washing the electrode substrate 40 after this rubbing processing (S10), as shown in drawing 18 R> 8 (c), the above-mentioned

resist 43 is exfoliated (S11).
[0352] Then, in order to realize different liquid crystal orientation from the liquid crystal orientation in orientation processing field 42a of the above 1st, as shown in drawing 18 (d), the part (1st orientation processing field 42a) by which rubbing was already carried out is protected by the resist 44 for rubbing processing screens, and rubbing processing of an unsettled part is performed. That is, the resist ingredient for rubbing processing screens is applied on the orientation film 42 which exfoliated the resist 43 (S12). So that orientation processing fields other than 1st orientation processing field 42a on the above-mentioned orientation film 42 (2nd orientation processing field 42b) may be exposed after prebaking (S13) UV mask exposure (S14), development (S15), and curing (S16) are performed, and after that, with orientation processing field 42a of the above 1st, rubbing processing is performed to orientation processing field 42b of the above 2nd so that processing bearing may become separate (S17). Subsequently, after washing the electrode substrate 40 after this rubbing processing (S18), as shown in drawing 18 (e), the above-mentioned resist 44 is exfoliated (S19). Thereby, the orientation film 42 (orientation device) by which orientation processing was carried out was obtained in two kinds of the different bearings.
[0353] Thus, with the gestalt of this operation, orientation processing patterning was carried out [processing] by the resist is performed twice or more. At this time, it is possible to realize at least two kinds of liquid crystal orientation (for example, two or more kinds of parallel orientation where the directions of orientation differ) what (orientation processing of 2 bearing is performed by two orientation processings in the above-mentioned explanation) processing bearing is changed for for every orientation processing. And in this way, by changing orientation processing bearing with one [at least] substrate (electrode substrate), the orientation of the reflective display 9 and the transparency display 10 can be set up independently, and a good display is attained.
[0354] Next, while realizing liquid crystal orientation which changes by the reflective display 9 and the transparency display 10 with approaches mentioned above, the liquid crystal display which used the polarizing plate 14-15 is explained below using a concrete example. However, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0355] [Example 10] In this example, the liquid crystal display was produced according to the manufacture approach of the liquid crystal display shown in said example 5 of a comparison. As the insulator layer 11 which consists of sensitization resin which has insulation is not specifically formed on a substrate 5 in an example 1 and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 4.5-micrometer liquid crystal thickness (d) and a (cel gap). And the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in this liquid crystal cell. The above-mentioned phase contrast compensating plate 16 and the phase contrast compensating plate 17 consisted of phase contrast compensating plates of every two sheets respectively.
[0356] However, in this example, orientation division was performed on the occasion of rubbing processing of the orientation film 3 by the approach shown in drawing 17 and drawing 18 (a) - drawing 18 (e), and the same approach. That is, in this example, to the orientation film 2 by the side of a substrate 4, rubbing was performed in the same bearing by the reflective display 9 and the transparency display 10, and to the orientation film 3 (orientation device) by the side of a substrate 5, rubbing was performed in the bearing which is different by the reflective display 9 and the transparency display 10 so that liquid crystal orientation bearings might differ by the reflective display 9 and the transparency display 10.

[0357] Moreover, in this example, the liquid crystal display mode using the liquid crystal orientation which is parallel (parallel to a substrate 4-5), and was twisted was used for the screen, and the display mode using the liquid crystal orientation which is parallel (parallel to a substrate 4-5), and is not twisted to the screen was used for the transparency display 10 at the reflective display 9.
[0358] Moreover, in this example, about 270nm and the twist angle (twist angle) of the orientation of liquid crystal are 70 degrees, and deltan-d of the liquid crystal layer 1 in the reflective display 9 produced the liquid crystal display about 270nm and whose twist angle (twist angle) of the orientation of liquid crystal deltan-d of the liquid crystal layer 1 in the transparency display 10 is 0 times. Consequently, the liquid crystal display which can perform a good display by both the reflective display 9 and the transparency display 10 was obtained, without having the liquid crystal layer 1 which was open for free passage by the reflective display 9 and the transparency display 10, and changing a cel gap.
[0359] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the transparency display 10, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 5 at the reflective display 9 list of the liquid crystal display obtained by this example using the criteria of common bearing.
[0360] In addition, the Gentlemen phase reference compensating plate which the optical arrangement shown in Table 5 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each bearing in Table 5 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0361]
[Table 5]

[0362] Next, actuation of each optical element in the gestalt of this operation is explained below. First, the case where the electrical potential difference is not impressed to the liquid crystal layer 1 is explained. In this case, according to orientation processing bearing of the orientation film 2-3

established, the orientation, i.e., each electrode substrate, of the substrate interface which touches this liquid crystal layer 1, orientation of the liquid crystal in the above-mentioned liquid crystal layer 1 is carried out. For example, with the liquid crystal display obtained in the above-mentioned example 10, when not mixing a chiral additive in a liquid crystal constituent, twist orientation is carried out to 70 left, and it is in the 0 times twist orientation condition which is not twisted by the transparency display 10 at the reflective display 9.
[0363] For this reason, by the reflective display 9, when the electrical potential difference is not impressed to the liquid crystal layer 1, if deltan-d of the liquid crystal layer 1 is set as about 270nm, if the circular polarization of light carries out incidence of this liquid crystal layer 1, it will act so that the linearly polarized light may be made to change and penetrate it. It is changed into the circular polarization of light by the phase contrast compensating plate 16, and by the liquid crystal layer 1, the light which carries out incidence to the liquid crystal layer 1 from a polarizing plate 14 side is further changed into the linearly polarized light from the circular polarization of light, it reaches the reflective film 8 and is reflected. When the electrical potential difference is not impressed to the liquid crystal layer 1 in the above-mentioned liquid crystal display from being again changed into the transparency component of a polarizing plate 14 when the light reflected by the reflective film 8 is the linearly polarized light on the reflective film 8, the display of the reflective display 9 will be clear display.
[0364] Moreover, by the transparency display 10, when the electrical potential difference is not impressed to the liquid crystal layer 1, if deltan-d of the liquid crystal layer 1 is set as 250nm - about 270nm, the liquid crystal layer 1 will act as 1/2 wavelength plate. That is, when the circular polarization of light by which incidence was carried out to the liquid crystal layer 1 turns into the circular polarization of light which intersects perpendicularly with the incidence **** circular polarization of light, for example, incidence of the right-handed circularly polarized light (right-handed-rotation circular polarization of light) is carried out, this right-handed circularly polarized light is changed into the left-handed circularly-polarized light (left-handed-rotation circular polarization of light), and when incidence of the left-handed circularly-polarized light is carried out, this circular polarization of light is changed into the right-handed circularly polarized light. The light which carried out incidence to the transparency display 10 passes a polarizing plate 15, it is changed into the circular polarization of light by the phase contrast compensating plate 17, and incidence is carried out to the liquid crystal layer 1 with it. In the above-mentioned example 10, the polarization condition is the counterclockwise circular polarization of light mostly, this circular polarization of light carries out incidence of the circular polarization of light by which incidence is carried out to the liquid crystal layer 1 from the above-mentioned phase contrast compensating plate 17 to the liquid crystal layer 1, and it is changed into the clockwise circular polarization of light. And in the phase contrast compensating plate 16, since the right-handed-rotation circular polarization of light is changed into the linearly polarized light of the transparency shaft orientations of a polarizing plate 14 and the left-handed-rotation circular polarization of light is changed into the linearly polarized light of absorption shaft orientations, when the electrical potential difference is not impressed to the liquid crystal layer 1 in the above-mentioned liquid crystal display, the display of the transparency display 10 will be clear display.
[0365] Next, the case where an electrical potential difference is impressed to the liquid crystal layer 1 is explained. If the electrical potential difference is impressed to the liquid crystal layer 1, irrespective of whether the liquid crystal in this liquid crystal layer 1 is the reflective display 9, or it is the transparency display 10, according to an electrical potential difference, orientation will be carried out at right angles to a substrate 4-5, and the above-mentioned polarization conversion operation will become weaker in connection with it. That is, in order that the circular polarization of light prepared by the phase contrast compensating plate 16-17 may pass the liquid crystal layer 1 as it is, also in the reflective display 9, a dark display is realized also in the transparency display 10.
[0366] In addition, in the above-mentioned example 10, the phase contrast compensating plate of a 115nm retardation is used for the phase contrast compensating plate 17. In order to realize the good

circular polarization of light only with the phase contrast compensating plate 17, although it is desirable that it is about 135nm as for the retardation of this phase contrast compensating plate 17, in order that the retardation may not disappear completely in an electrical potential difference with the practical liquid crystal layer 1 of the transparency display 10, the retardation of the above-mentioned phase contrast compensating plate 17 is set up so that good contrast may be acquired in consideration of this.
[0367] Moreover, the phase contrast compensating plate 16 has the operation which changes into the circular polarization of light of large wavelength the polarization condition of the light which carries out incidence to the liquid crystal layer 1 of the reflective display 9. And in the above-mentioned liquid crystal display, twist orientation of the liquid crystal layer 1 in the reflective display 9 is carried out 70 degrees, and the deltan-d is set as 270nm. For this reason, in the reflective display 9 in the above-mentioned liquid crystal display, the light which carries out incidence to the liquid crystal layer 1 is the circular polarization of light, and this circular polarization of light is changed into the linearly polarized light in the liquid crystal layer 1, passes the liquid crystal layer 1, and reaches to the reflective film 8. And the light which turned into the linearly polarized light on the reflective film 8 is reflected in the mirror plane of the reflective film 8, and even it passes each optical element by the reverse order, and becomes the linearly polarized light which finally has the oscillating electric field of transparency shaft bearing of a polarizing plate 14. For this reason, in the above-mentioned reflective display 9, it becomes clear display.
[0368] Moreover, the chiral agent which makes the orientation of liquid crystal produce a left twist of a proper is mixed in the used liquid crystal constituent. This chiral agent changes the helical pitch of a proper to the liquid crystal constituent with which this chiral agent was mixed with that addition. For this reason, this helical pitch is adjusted and it becomes possible to make the electrical-potential-difference dependency of lightness in agreement by the reflective display 9 and the transparency display 10 using the minimum electrical potential difference from which liquid crystal orientation begins to change with helical pitches changing.
[0369] Thus, the display property of a liquid crystal display given in the produced example 10 is shown in drawing 19 . In addition, the display property shown in drawing 1919 is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability).
[0370] In drawing 19 , a curve 331 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 10, and a curve 332 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 10.
[0371] When not impressing an electrical potential difference, the above-mentioned liquid crystal display obtained in the example 10 performed clear display, and the display by the so-called Nor Marie White (NW) mode in which a reflection factor and permeability decrease with impression of an electrical potential difference realized it with this liquid crystal display, so that drawing 19 might show. Moreover, the above-mentioned liquid crystal display can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while being able to set up a contrast ratio almost to the same extent by the reflective display 9 and the transparency display 10, and it can realize the display excellent in visibility.
[0372] As mentioned above, both the things set up as a concrete means for changing liquid crystal orientation by the reflective display 9 and the transparency display 10 so that the twist angles of the liquid crystal layer 1 may differ by the reflective display 9 and the transparency display 10 are effective in order to realize a good display by the reflective display 9 and the transparency display 10.
[0373] In addition, although rubbing processing of bearing which is different by the reflective display 9 and the transparency display 10 is performed and twist orientation of the liquid crystal layer 1 of the reflective display 9 is carried out in the above-mentioned example 10 in order to change the twist angle of the liquid crystal layer 1 by the reflective display 9 and the transparency display 10 Although the

liquid crystal layer 1 of the transparency display 10 used the combination which has not carried out twist orientation, especially the means for changing the twist angle of the liquid crystal layer 1 by the reflective display 9 and the transparency display 10 is not limited.

[0374] For example, it is (1) in addition to the above-mentioned combination shown in an example 10. The combination from which the twist angle and sense of the twist differ although twist orientation of both the liquid crystal layer 1 in the reflective display 9 and the liquid crystal layer 1 in the transparency display 10 is carried out, (2) Although the liquid crystal layer 1 in the reflective display 9 is not twisted, the liquid crystal layer 1 in the transparency display 10 may use the combination currently twisted. (3) the inclinations (the so-called pre tilt) of the liquid crystal to a substrate 4-5 differ by the reflective display 9 and the transparency display 10 -- you may combine and come out. Moreover, (4) Change of the liquid crystal orientation in a substrate interface may be combined with other means of this invention, and it is (5). That from which a cel gap differs by the reflective display 9 and the transparency display 10, and (6) Electric fields may differ by the reflective display 9 and the transparency display 10.

[0375] [Gestalt 5 of operation] Although each example in the gestalten 2-4 of said operation explained the configuration for realizing a good transparency display in a good reflective display list using the liquid crystal display in which liquid crystal is carrying out orientation in parallel to the substrate, with the gestalt of this operation, orientation bearing of liquid crystal explains a perpendicular liquid crystal display to a substrate like the example 1 in the gestalt 1 of said operation. However, with the gestalt of this operation, the design for performing the display which used the birefringence or optical activity (polarization conversion operation) of liquid crystal using the polarizing plate was performed, without mixing dichroism coloring matter in a liquid crystal layer. In addition, the same number is given to the component which has the function as the gestalt 4 of the gestalt 1 of the following and said operation - operation of explanation same for convenience, and the explanation is omitted.

[0376] In the liquid crystal display concerning the gestalt of this operation, a dielectric constant anisotropy uses negative liquid crystal for the liquid crystal layer 1. Moreover, the perpendicular orientation film which carries out orientation of the liquid crystal to the orientation film 2-3 which pinches the liquid crystal layer 1 perpendicularly is used. In this case, although orientation of the liquid crystal molecule is carried out almost perpendicularly to the substrate 4-5 (screen) while not impressing the electrical potential difference to the liquid crystal layer 1, with impression of an electrical potential difference, it inclines from [of a substrate 4-5] a normal, and orientation of it is carried out and it produces a polarization conversion operation to the light which passes in the direction of a normal of the layer of the layer-like liquid crystal layer 1.

[0377] In the liquid crystal display concerning the gestalt of this operation, even if the difference between the liquid crystal display using the orientation film 2-3 in which liquid crystal carries out orientation in parallel with a substrate, and the liquid crystal display concerning the gestalt of this operation does not impress an electrical potential difference, it is that liquid crystal carries out orientation in the direction of a normal of a substrate 4-5 to the layer of an interface with the electrode substrate in the liquid crystal layer 1. Then, with the gestalt of this operation, in order to use this effectively, in not impressing an electrical potential difference to a display, it uses NB (Nor Marie Black) mode which becomes a black display. Specifically by the reflective display 9, it displays on the liquid crystal layer 1 by carrying out incidence of the circular polarization of light. moreover, from the phase contrast compensating plate 16 used also for a reflective display acting on polarization of the outgoing radiation light from the liquid crystal layer 1 in the transparency display 10 In order to drive the above-mentioned liquid crystal layer 1 by the electrode pair which connects the reflective display 9 and the transparency display 10 electrically and to realize a dark display to coincidence, in consideration of the liquid crystal layer 1 carrying out orientation at right angles to a substrate 4-5 also in a transparency display, incidence of the circular polarization of light is carried out to the liquid crystal layer 1. For this reason, in the combination of a polarizing plate 14-15 and the phase contrast compensating plate 16-17, the retardation of the phase contrast compensating plate arranged by the liquid crystal layer 1 at the

near side among two or more phase contrast compensating plates which constitute the phase contrast compensating plate 17 is set as 135nm. Thereby, with the gestalt of this operation, good NB display is realizable.

[0378] Next, in the combination of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 mentioned above, a setup of the liquid crystal layer 1 which gives good clear display is explained.

[0379] With the gestalt of this operation, as mentioned above, from [of a substrate 4-5] a normal, it inclines and orientation of the liquid crystal layer 1 is carried out with impression of an electrical potential difference. It is desirable to act so that the circular polarization of light may be changed into the linearly polarized light, and to act to the transparency display 10 to the reflective display 9, as this liquid crystal layer 1, so that the circular polarization of light may be changed into the circular polarization of light of the circumference of reverse where an electrical potential difference is fully impressed to this liquid crystal layer 1. When the above-mentioned liquid crystal layer 1 does the above-mentioned conversion operation so, good clear display can be realized.

[0380] In order for the above-mentioned liquid crystal layer 1 to do the above-mentioned conversion operation so, it is desirable to carry out orientation processing of the orientation film 2-3 so that liquid crystal may not be made to produce the twist, and not to use a chiral additive for a liquid crystal constituent. That is, it is desirable to set up the liquid crystal layer 1 so that it may change lambda/4 in the reflective display 9 and may change with impression of the electrical potential difference to this liquid crystal layer 1 lambda/2 by the transparency display 10, when the retardation of the liquid crystal layer 1 sets wavelength of incident light to lambda.

[0381] When being set up so that the thickness of the liquid crystal layer 1 in the reflective display 9 may differ from the thickness of the liquid crystal layer 1 in the transparency display 10, it is easy to set up, as the liquid crystal layer 1 was mentioned above so that the liquid crystal layer 1 may do the above-mentioned conversion operation so.

[0382] Although a concrete example is hereafter given and explained about the liquid crystal display concerning the gestalt of this operation, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0383] [Example 11] In this example, the liquid crystal cell for liquid crystal impregnation from which liquid crystal thickness differs by the reflective display 9 and the transparency display 10 was produced by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, and the perpendicular orientation film which has the operation which carries out orientation of the liquid crystal to the orientation film 2 and 3 perpendicularly to a substrate 4 and 5 was used. Orientation processing was performed so that liquid crystal might incline on the above-mentioned orientation film 2-3 a little and might carry out orientation to it from normal bearing (perpendicular direction) of a substrate 4-5 by rubbing.

[0384] In this example, the liquid crystal thickness (d) in the reflective display 9 However, 3 micrometers, While liquid crystal thickness (d) in the transparency display 10 is set to 6 micrometers and a refractive-index difference (deltan) forms the liquid crystal layer 1 in a liquid crystal ingredient using the liquid crystal which has the negative dielectric constant anisotropy of 0.06 The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell, and the liquid crystal display was produced. The above-mentioned phase contrast compensating plate 16 and the phase contrast compensating plate 17 consisted of phase contrast compensating plates of every two sheets respectively.

[0385] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the transparency display 10, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 6 at the reflective display 9 list of the liquid crystal display obtained by this example using the criteria of common bearing.

[0386] In addition, the Gentlemen phase reference compensating plate which the optical arrangement

shown in Table 6 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each bearing in Table 6 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0387]
[Table 6]

[0388] Thus, the display property of a liquid crystal display given in produced this example is shown in drawing 20 . In addition, the display property of a publication is measured by the same approach as an example 1 to drawing 20 R> 0, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability).
[0389] In drawing 20 , a curve 341 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 11, and a curve 342 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 11.
[0390] When not impressing an electrical potential difference, the above-mentioned liquid crystal display obtained in the example 11 performed the dark display, and the display by the so-called NB mode which a reflection factor and permeability increase with impression of an electrical potential difference realized it with this liquid crystal display, so that drawing 20 might show. Moreover, the above-mentioned liquid crystal display can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while being able to set up a contrast ratio almost to the same extent by the reflective display 9 and the transparency display 10, and it can realize the display excellent in visibility.
[0391] According to the gestalt of this operation, as mentioned above, by the reflective display 9 and

the transparency display 10 In the liquid crystal display concerning this invention which realizes liquid crystal orientation which is different in coincidence By using at least for one side the orientation means (perpendicular orientation film) to which orientation of the liquid crystal is carried out at right angles to the substrate side which touches this liquid crystal (liquid crystal layer 1) among the reflective display 9 or the transparency display 10 It was checked that the transflective type liquid crystal display which can perform a good display by both the reflective display 9 and the transparency display 10 is realized.
[0392] [Gestalt 6 of operation] With the gestalt of this operation, when displaying by changing liquid crystal orientation on an electrical potential difference, in either [at least] a reflective display or a transparency display, the liquid crystal display which displays by changing orientation bearing of liquid crystal is explained, maintaining the orientation condition of liquid crystal in the parallel condition to the screen (substrate). That is, in the liquid crystal display concerning the gestalt of this operation, a liquid crystal molecule rotates in parallel to the screen (substrate) in either [at least] a reflective display or a transparency display by impression of an electrical potential difference.
[0393] Although the liquid crystal display concerning the gestalt of this operation is hereafter explained using a concrete example, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples. In addition, the same number is given to the component which has the function as the gestalt 5 of the gestalt 1 of said operation - operation of explanation same for convenience, and the explanation is omitted.
[0394] [Example 12] At this example, by using for transflective type liquid crystal the IPS (in plane switching) mode used in order for a transparency mold liquid crystal display to realize a wide-field-of-view angle, a liquid crystal molecule is rotated in parallel to a substrate to a substrate by the horizontal electric field of field inboard, and the liquid crystal display which gave the optical switch function is explained below with reference to drawing 21 (a) and drawing 21 (b).
[0395] In addition, conventionally, although the IPS mode itself was used in the field of a transparency mold liquid crystal display, since liquid crystal orientation change was inadequate for a transparency display, the liquid crystal orientation on the above-mentioned Kushigata electrode was not able to be contributed to a display, and was not able to realize a good display on the Kushigata electrode used at the time of this IPS mode use. However, according to this example, by the conventional IPS method, a reflective display can be realized in the field on Kushigata wiring which was not able to be used, and the use effectiveness of light can obtain a transflective type high liquid crystal display.
[0396] Drawing 21 (a) is an important section sectional view at the time of no electrical-potential-difference impressing the liquid crystal display concerning this example, and drawing 21 R> 1 (b) is an important section sectional view at the time of electrical-potential-difference impression of the liquid crystal display shown in drawing 21 (a). In addition, drawing 21 (a) and drawing 21 (b) show a cross section when each cuts the liquid crystal cell in this liquid crystal display in respect of being perpendicular to bearing in which electrode wiring (terminal) of the Kushigata electrode in which it was prepared by this liquid crystal cell is prolonged.
[0397] The liquid crystal display shown in drawing 21 (a) and drawing 21 (b) the substrate 51 with which the liquid crystal layer 1 has translucency, and the Kushigata electrode 53 (the contents rewriting means of a display --) which has light reflex nature While being pinched with the substrate 54 which possesses light reflex nature by having an electrical-potential-difference impression means and an orientation device and equipping the outside (namely, the opposed face with a substrate 54 opposite side) of a substrate 51 with the phase contrast compensating plate 16 and a polarizing plate 14 further It has the configuration which equipped the outside (namely, the opposed face with a substrate 51 opposite side) of a substrate 54 with the phase contrast compensating plate 17 and the polarizing plate 15. In addition, the phase contrast compensating plate 16 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 17 from this example.
[0398] In one [among the substrates of a pair with which, as for the above-mentioned liquid crystal

display, this example was also prepared on both sides of the above-mentioned liquid crystal layer 1] substrate 54 (electrode substrate) On a glass substrate 52, the sensitization resin which has insulation is applied with a spin coat, and sensitization resin does not remain in the transparency display 10 by the mask exposure of ultraviolet radiation further. In the reflective display 9 Pattern formation of the insulator layer 11 (orientation device) is carried out so that this sensitization resin may be formed in predetermined thickness. Thereby, the thickness of the liquid crystal layer 1 in the transparency display 10 is set up more thinly than the thickness of the liquid crystal layer 1 in the reflective display 9.
[0399] Moreover, in the above-mentioned liquid crystal display concerning this example, on the above-mentioned glass substrate 52, the Kushigata electrode 53 (orientation device) which has light reflex nature is formed so that the above-mentioned insulator layer 11 may be covered. This Kushigata electrode 53 is a reflective pixel electrode which serves both as the liquid crystal drive electrode which drives the liquid crystal layer 1, and the reflective film (reflective means), and is produced with the metal with the high reflection factor of light.
[0400] In the above-mentioned liquid crystal display, the orientation condition of liquid crystal molecule 1a changes with the electric fields by which the seal of approval is carried out with the Kushigata electrode 53 by the transparency display 10. Moreover, in the reflective display 9, while the liquid crystal layer 1 drives by the electric field by the above-mentioned Kushigata electrode 53, the reflex action of the above-mentioned Kushigata electrode 53 is used for the display.
[0401] In addition, in this example, although wiring of the Kushigata electrode 53 is used for the reflective means, in order to give light-scattering nature to this Kushigata electrode 53, the film which has light-scattering nature may be further formed in the field which concavo-convex structure may be formed in the front face, and counters the Kushigata electrode 53 in the outside of a glass substrate 51.
[0402] In the liquid crystal display shown in drawing 21 (a) and drawing 21 (b), mutually different potential is given to Kushigata electrode 53aand53b which adjoins each other mutually, and electric field arise between the above-mentioned Kushigata electrode 53a and 53b. As shown in drawing 21 (b), the transparency display 10 is equivalent to the gap section of Kushigata electrode 53a and 53b, and in this part, liquid crystal orientation maintains bearing where that orientation bearing is parallel to a glass substrate 52, and changes with above-mentioned Kushigata electrode pairs (Kushigata electrode 53aand53b) a lot. Moreover, the reflective display 9 is equivalent to right above [of the Kushigata electrode 53 (Kushigata electrode 53aand53b)], and liquid crystal orientation changes also to perpendicular bearing in this part not only to change of bearing but to the glass substrate 52 along the flat surface of a glass substrate 52. This is because line of electric force has the component perpendicular to a glass substrate 52 by the reflective display 9 to line of electric force (a broken line showing among drawing) being prolonged almost in parallel to a glass substrate 52 in the transparency display 10, as shown in drawing 21 (b).
[0403] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the transparency display 10, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 7 at the reflective display 9 list of the liquid crystal display concerning this example using the criteria of common bearing.
[0404] In addition, the Gentlemen phase reference compensating plate which the optical arrangement shown in Table 7 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 17 is indicated in order of the actual arrangement from an observer side.
[0405] Moreover, orientation bearing (orientation bearing of the major axis of liquid crystal molecule 1a) of the liquid crystal layer 1 is equal to rubbing processing bearing in substrate 51 front face in a substrate 51 side, and equal to rubbing processing bearing in substrate 54 front face in a substrate 54 side. Hereafter, substrate 51 orientation bearing and orientation bearing of the liquid crystal layer 1 by the side of a substrate 54 are described for orientation bearing of the liquid crystal layer 1 by the side

of a substrate 51 as substrate 54 orientation bearing.
[0406] Moreover, each bearing in Table 7 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0407] The direction where electrode wiring (terminal) of the Kushigata electrode 53 is prolonged here is 65-degree bearing, and it changed so that liquid crystal molecule 1a which liquid crystal orientation is with the transparency display 10 and the reflective display 9, and has turned to both bearings 75 degrees with impression of an electrical potential difference might have bigger bearing than bearing 75 degrees. Moreover, in the above-mentioned liquid crystal display, deltan-d of the liquid crystal layer [in / in deltan-d of the liquid crystal layer 1 in the reflective display 9 / 130nm order and the transparency display 10] 1 is set up before and after 240nm.
[0408]
[Table 7]

[0409] In the liquid crystal display set up as mentioned above, when not impressing an electrical potential difference to the liquid crystal layer 1, both the reflective display 9 and the transparency display 10 become a dark display. And if an electrical potential difference is impressed to the liquid crystal layer 1 from this condition, that orientation bearing will change so that liquid crystal molecule 1a may swerve from bearing (the above-mentioned setup 65-degree bearing) where electrode wiring (terminal) of the Kushigata electrode 53 is prolonged. Therefore, in the above-mentioned liquid crystal display, clear display is realized by changing orientation bearing of the liquid crystal at the time of electrical-potential-difference impression.
[0410] Thus, the produced display property of the liquid crystal display concerning this example is shown in drawing 22 . In addition, the display property of a publication is measured by the same approach as an example 1 to drawing 22 R> 2, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability).
[0411] In drawing 22 , a curve 351 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 12, and a

curve 352 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 12. In addition, although the reflective display 9 has a difference in an optical property with the location on the Kushigata electrode 53, it has indicated the optical property of a typical part here.

[0412] When the above-mentioned liquid crystal display obtained in the example 12 does not impress an electrical potential difference so that drawing 22 may show, both the reflective display 9 and the transparency display 10 perform a dark display, and a reflection factor and permeability increase them with impression of an electrical potential difference with this liquid crystal display. Moreover, both the reflection factor of the reflective display 9 in case applied voltage is 2V, and the permeability of the transparency display 10 were 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 38% 35%. Therefore, according to the above-mentioned liquid crystal display, it can be [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9, and the display excellent in visibility can be realized. Moreover, according to the above-mentioned liquid crystal display, from exceeding the contrast ratio in the reflective display 9, the contrast ratio in the transparency display 10 can raise display grace further, and can perform a good display.

[0413] As mentioned above, according to the above-mentioned example 12, by the conventional IPS method, the reflective display was realized in the field on the Kushigata wiring 53 which was not able to be used for the display, and it checked that the use effectiveness of light could obtain a transflective type high liquid crystal display.

[0414] In the gestalt of this operation, the approach of using a ferroelectric liquid crystal display mode besides the approach of using a pneumatic liquid crystal like the IPS mode mentioned above as an approach of realizing liquid crystal orientation mentioned above, the method of using antiferroelectricity liquid crystal display mode, etc. can be used.

[0415] So, the following examples 13 explain the liquid crystal display which used the ferroelectric liquid crystal display mode for the display as other liquid crystal displays which realize liquid crystal orientation mentioned above.

[0416] [Example 13] In the liquid crystal display shown in an example 1 by this example A surface passivation ferroelectric liquid crystal is used for a liquid crystal ingredient. Liquid crystal thickness (d) by the transparency display 10 1.4 micrometers, While it sets up so that it may be set to 0.7 micrometers by the reflective display 9, and setting up so that deltan-d of this liquid crystal layer 1 may be set to 130nm by the reflective display 9 and may be set to about 260nm by the transparency display 10 Instead of forming the reflective film 8 on the electrode 7 corresponding to the reflective display 9, the liquid crystal cell shown in an example 1 and the liquid crystal cell designed similarly were produced except having used the reflector for the field corresponding to the reflective display 9 as an electrode.

[0417] Pattern formation of the insulator layer 11 was carried out so that sensitization resin might not remain in the transparency display 10 but it might specifically be formed by the reflective display 9 on a substrate 5 (glass substrate) at the thickness this whose sensitization resin is 0.7 micrometers, the reflector was produced in this insulator layer 11 formation section (reflective display 9), and the transparent electrode was produced in the insulator layer 11 agenesis section (transparency display 10). And the electrode substrate was produced by forming the orientation film 3 on the above-mentioned electrode forming face in this substrate 5, and performing orientation processing by rubbing. In addition, the configuration of an electrode substrate (opposite substrate) which carries out opposite arrangement is the same as that of a thing given in an example 1 to this electrode substrate. And the ferroelectric liquid crystal constituent containing the above-mentioned surface passivation ferroelectric liquid crystal was introduced between the above-mentioned two-electrodes substrates, the liquid crystal cell was produced, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in this liquid crystal cell, and the liquid crystal display was produced. In addition, the phase contrast compensating plate 16 was constituted from a phase contrast

compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 17 from this example.
[0418] optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list -- orientation bearing of the liquid crystal of clear display and a dark display) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 8 using the criteria of common bearing.
[0419] In addition, the Gentlemen phase reference compensating plate which the optical arrangement shown in Table 8 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 17 is indicated in order of the actual arrangement from an observer side. Moreover, each bearing in Table 8 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0420]
[Table 8]

[0421] Thus, the produced liquid crystal display was a liquid crystal display which both has good lightness and a good contrast ratio by the reflective display 9 and the transparency display 10.
[0422] As mentioned above, if it is the liquid crystal display which realizes liquid crystal thickness by the reflective display 9 and the transparency display 10 in a liquid crystal orientation list which is different in coincidence, even if the orientation change direction of the liquid crystal layer 1 by the seal of approval of an electrical potential difference changes in a liquid crystal layer flat surface, a display good as a transflective type liquid crystal display of this invention can be obtained. And when the above-mentioned liquid crystal display uses IPS mode, it is more possible than the conventional transparency mold liquid crystal display which similarly used IPS mode to improve the use effectiveness of light. Moreover, the above-mentioned liquid crystal display concerning the gestalt of this operation is usable also by the modes, such as a ferroelectric liquid crystal.
[0423] [Gestalt 7 of operation] The gestalt of this operation explains the concrete component substrate and color filter substrate of a active-matrix drive which enable the configuration of the liquid crystal

display concerning this invention.
[0424] When producing the liquid crystal display applied to this invention for the purpose of image display, it is important for the ratio of a transparency display and a reflective display practically to design according to the operating frequency of the case where it uses for a transparency display, and the case where it uses for a reflective display.
[0425] That is, the 1st use gestalt is a use gestalt (it abbreviates to transparency subject half transparency hereafter) which uses the transmitted light from the lighting system (back light) as a background lighting means for a main display, and uses a reflective display for prevention of a washout like the transparency mold liquid crystal display used now.
[0426] Moreover, the 2nd use gestalt is a use gestalt which uses a reflective display for a main display, its surrounding illumination light is weak while the light is often put out according to a situation and the large back light of power consumption aims at reduction of power consumption, and when the check of the contents of a display cannot be performed only in a reflective display, it is the use gestalt (it omits with reflective subject half transparency hereafter) which turns on and uses a back light.
[0427] In two kinds of such use gestalten, since whether a main display is performed by transparency display differs from whether it carries out by reflective display, the design of the color of the ratio of the screen product of a transparency display and a reflective display and the color filter in the case of color display becomes a thing different, respectively.
[0428] Then, the liquid crystal display which uses for a display first the TFT component which is one of the active matrices is mentioned as an example, and the liquid crystal display of a transparency subject transflective type which made transparency the subject is explained below. In addition, the same number is given to the component which has the function as the gestalt 6 of the gestalt 1 of said operation – operation of explanation same for convenience, and the explanation is omitted.
[0429] First, the substrate structure of the liquid crystal display of a transparency subject transflective type of using a TFT component for a display is explained below with reference to drawing 23 (a) – drawing 25 .
[0430] Drawing 23 (a) is the important section top view of the TFT component substrate for realizing the liquid crystal display of a transparency subject transflective type concerning the gestalt 7 of this operation. Drawing 23 (b) It is drawing showing the drive electrode 19 of the reflective display 9 (refer to drawing 1 , drawing 4 , drawing 24 , and drawing 25) in the TFT component substrate shown in drawing 23 R> 3 (a), and drawing 23 (c) is drawing showing the transparence pixel electrode 20 in the TFT component substrate shown in drawing 23 (a).
[0431] Moreover, drawing 24 is the A–A' line view sectional view of the TFT component substrate shown in drawing 23 (a), and is drawing shown in the cross section which passes further along the auxiliary part by volume 26 in more detail the TFT component substrate shown in drawing 23 (a) through the TFT component 21 to the drive electrode 19, and the transparence pixel electrode 20. Furthermore, drawing 25 is the B–B' line view sectional view of the TFT component substrate shown in drawing 23 (a), and shows the cross-section structure of the boundary part of adjacent pixels.
[0432] The pixel electrode 18 which drives the liquid crystal layer 1 (refer to drawing 1 and drawing 4) is constituted by the transparence pixel electrode 20 (the contents rewriting means of a display, electrical-potential-difference impression means) which consists of the drive electrode 19 (the contents rewriting means of a display, electrical-potential-difference impression means) and ITO of the reflective display 9 as shown in drawing 23 (a), drawing 24 , and drawing 25 R> 5. In addition, the above-mentioned drive electrode 19 may be a reflector with which itself has reflexibility. Moreover, in the case of the means of displaying in which not showing reversal of light and darkness even if the liquid crystal display method used for a display expresses as the same electrical potential difference, the drive electrode 19 and the transparence pixel electrode 20 of each other may be connected electrically.
[0433] The above-mentioned drive electrode 19 and the transparence pixel electrode 20 are connected to the drain terminal 22 of the TFT component 21 which controls the electrical potential difference used

for a display by each pixel unit. Moreover, opening 19a for a transparency display is formed in the drive electrode 19, and when the above-mentioned drive electrode 19 is a reflector, this opening 19a formation field for a transparency display is used for a transparency display as a transparency display 10.
[0434] The TFT component 21, wiring 23 and wiring 24, the auxiliary part by volume 26, and the auxiliary capacity line 27 are arranged at the lower layer of the above-mentioned drive electrode 19. However, with the gestalt of this operation, since the quality of the material with protection-from-light nature, such as a metal, is used for these components, the above-mentioned TFT component substrate is produced so that these components may not be arranged in opening 19a for a transparency display. In addition, in drawing 23 (a), a two-dot chain line shows the drive electrode 19.
[0435] Moreover, as shown in drawing 24 , the main part of the drive electrode 19 of this reflective display 9 that impresses an electrical potential difference to the reflective display 9 which constitutes the pixel electrode 18 is separated from substrate 19 front face (TFT component substrate side) in which the wiring 23-24 for the drive of the above-mentioned TFT component 21 and the above-mentioned TFT component 21 were formed by the organic compound insulator 25. This organic compound insulator 25 is formed so that it may be formed in an organic insulating material with a low dielectric constant and thickness may be set to 3 micrometers. The parasitic capacitance component formed between gate wiring of the TFT component 21, the becoming wiring 23, the wiring 24 used as the source wiring of the TFT component 21, and the pixel electrode 18 this It prevents that you delay the gate signal wave and source signal wave form which control the switching action of the TFT component 21, or make it distorted. While it is because the dot-matrix display with high resolution is enabled, it is for making good the optical property in the reflective display 9 and the transparency display 10 in the liquid crystal display concerning the gestalt of this operation.
[0436] The above-mentioned pixel electrode 18 is connected to the drain terminal 22 of the above-mentioned TFT component 21. This drain terminal 22 is n+ doped by n mold. It is an amorphous silicon layer and acts as a drain electrode of the TFT component 21. In the above-mentioned TFT component substrate concerning the gestalt of this operation, the ITO layer arranged so that this drain terminal 22 may be touched is used as a transparence pixel electrode 20, and the drive electrode 19 of the reflective display 9 is formed on the organic compound insulator 25 by which patterning was carried out so that a part of that transparence pixel electrode 20 might be covered further. That is, with the liquid crystal display of a transparency subject transflective type using the TFT component substrate shown in drawing 24 , the above-mentioned transparence pixel electrode 20 used for a transparency display and the above-mentioned drive electrode 19 used for a reflective display are electrically connected in the pattern boundary section of an organic compound insulator 25. Moreover, smooth irregularity may be formed in the front face as shown in the drive electrode 19 of the reflective display 9 for the purpose of mirror plane-ized prevention of the screen at drawing 24 and drawing 25 .
[0437] Moreover, as shown in drawing 25 , in the boundary part of the adjacent pixels in the above-mentioned TFT component substrate, an organic compound insulator 25 is formed so that the wiring 24 connected to the source terminal 28 of the TFT component 21 may be covered, and the drive electrode 19 of the reflective display 9 is formed on this organic compound insulator 25.
[0438] Thus, since the produced TFT component substrate can control the parasitic capacitance component in which the pixel electrode 18 and wiring 23-24 form the relation between the thickness of an organic compound insulator 25, and a dielectric constant through an organic compound insulator 25 by setting up appropriately, as shown in drawing 23 (a), it can lengthen the drive electrode 19 of the reflective display 9 to wiring 23 and right above [of 24]. In this case, since it becomes possible to design the gap of pixel electrode 18 adjacent comrades narrowly and the leakage electric field from the wiring 23-24 to the liquid crystal layer 1 decrease in a pixel gap, the orientation of the liquid crystal layer 1 is a pile to turbulence. Therefore, by setting up appropriately the relation between the thickness of an organic compound insulator 25, and a dielectric constant, control of the liquid crystal orientation of the liquid crystal layer 1 is attained to near the boundary of pixel electrode 18 comrades, and can

produce the TFT component substrate of the so-called high liquid crystal display of a transparency subject transflective type of a numerical aperture. With the gestalt of this operation, in the organic insulating material of 3.5, specific inductive capacity formed [thickness] the above-mentioned organic compound insulator 25 so that it might be set to 3 micrometers.

[0439] The area which can be used for a transparency display with the gestalt of this operation as mentioned above produced the TFT component substrate with which the area which can be used for a reflective display occupies 38% of the whole pixel 45% of the area of the whole pixel. It can say that it is the TFT component substrate of the high liquid crystal display of a transparency subject transflective type of the use effectiveness of the light which can be used for a display in order that this TFT component substrate may secure the rate of the almost equivalent transparency display 10 and may display by adding the display light reinforcement of the reflective display 9 to transparency display light as compared with the numerical aperture of the transparency display of the TFT-liquid-crystal display of the transparency mold used more widely than before being just over or below 50%.

[0440] Thus, high efficiency for light utilization is realizable with the gestalt of this operation, because it is possible to arrange the component which does not penetrate the light of the TFT component 21, wiring 23-24 and the auxiliary part by volume 26, and auxiliary capacity line 27 grade to the reflective display 9, and it is because the light used for a liquid crystal display with these components is not spoiled.

[0441] Next, the color filter substrate which is made to counter the TFT component substrate produced in this way, and is used is explained below with reference to drawing 26 R> 6 (a) and drawing 26 (b).

[0442] As shown in the above-mentioned color filter substrate at drawing 26 (a) and drawing 26 (b), color filter 61 R.61G and 61B of three colors of red (R), green (G), and blue (B) are formed. Color filter 61 R.61G and 61B of these 3 color are respectively formed with the resin of optical photosensitivity which distributed the pigment, by the photolithography technique, on the glass substrate 62, is a coloring layer currently formed in the flat-surface configuration of the shape of a stripe doubled with the pixel of a TFT component substrate, and is separated and formed for every color.

[0443] furthermore, on color filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62 As shown in drawing 26 R> 6 (b), so that these color filter 61 R.61G and 61B may be covered The smoothing layer 501 is formed with transparence acrylic resin, and on it as a counterelectrode 502 (the contents rewriting means of a display, electrical-potential-difference impression means) of the pixel electrode 18 in a TFT component substrate ITO of 140nm thickness is formed by sputtering using the wrap electric shielding mask except the predetermined field. Thereby, the above-mentioned color filter 61 R.61G and 61B are separated in the transparent field for every color.

[0444] The physical relationship of the superposition of the above-mentioned color filter substrate and a TFT component substrate Opening 19for transparency display a of the drive electrode 19 which is as being shown in drawing 26 (a), and was formed in the reflective display 9 of a TFT component substrate While (namely, the transparency display 10) is completely covered with color filter 61 R.61G and 61B of the shape of a stripe of R, G, and B, in the reflective display 9 Only the part of the extension direction of color filter 61 R.61G and 61B in the above-mentioned drive electrode 19 is covered with the above-mentioned color filter 61 R.61G and 61B. Opposite arrangement of the transparence field between these color filter 61 R.61G and 61B is carried out to the field (parts other than the extension direction of the above-mentioned color filter 61 R.61G and 61B) of others of the drive electrode 19 formed in the reflective display 9.

[0445] Arrangement with the reflective display 9 and the transparency display 10, and color filter 61 R.61G and 61B is shown in drawing 27 combining the above-mentioned color filter substrate and a TFT component substrate. drawing 27 -- a color filter -- a substrate -- TFT -- a component -- a substrate -- a liquid crystal display -- ****** -- using it -- a location -- superposition -- the above -- a color filter -- a substrate -- TFT -- a component -- a substrate -- drawing 26 -- (-- a --) -- it can set -- C-C -- ' -- a location -- having cut -- the above -- drawing 26 -- (-- a --) -- a publication -- a liquid

crystal display -- an important section -- C-C -- ' -- a line -- a view -- a sectional view -- it is .
[0446] Thus, respectively, which color filter 61 R.61G and 61B of R, G, and B are formed by the transparency display 10, and parts other than the extension direction of the above-mentioned color filter 61 R.61G and 61B in the reflective display 9 support the transparence field between the above-mentioned color filter 61 R.61G and 61B at it.
[0447] Color filter 61 R.61G and 61B used for a transparency display, and color filter 61 R.61G [same] and 61B act on a part of reflective display 9 by this, and color filter 61 R.61G and 61B do not act on the remaining reflective display 9. By this, also to a reflective display, a color display (color display) is attained and a reflection factor required for a reflective display can be secured.
[0448] In addition, the transparency color which appears in the light which penetrated the color filter substrate produced as shown in said drawing 26 (a) and drawing 26 (b) may have the same color as the transparency color of R, G, and B which are used in a transparency mold liquid crystal display for every R, G, B, and pixel, and may be further adjusted suitably according to an application.
[0449] In the combination of the TFT component substrate and·color filter substrate which are shown in above-mentioned drawing 26 (a) and drawing 27 The transparency display 10 expresses all as the light which passes color filter 61 R.61G and 61B. The reflective display 9 The part performs the display using the same color filter 61 R.61G and 61B as the transparency display 10, it is the remaining part, and it shows without using color filter 61 R.61G and 61B. Since this runs short of lightness if color filter 61 R.61G and 61B of the transparency display 10 are used for the reflective display 9 as it is, it is because it aims at preparing the part which does not use color filter 61 R.61G and 61B in the reflective display 9, and compensating lightness.
[0450] Furthermore, in consideration of display light passing color filter 61 R.61G and 61B twice, high color filter 61 R.61G and 61B of lightness may be prepared in the reflective display 9 like the gestalt of this operation rather than color filter 61 R.61G and 61B in the transparency display 10.
[0451] Moreover, with the gestalt of this operation, color filter 61 R.61G and 61B are formed in the transparency display 10 at least according to the purpose of use, and it is good for the reflective display 9 also as a configuration which has the field (part) in which color filter 61 R.61G and 61B are not prepared, and good also as a configuration which uses color filter 61 R.61G and 61B only for the transparency display 10, and does not prepare color filter 61 R.61G and 61B in the reflective display 9.
[0452] When considering as the configuration which does not prepare color filter 61 R.61G and 61B in the reflective display 9, a display voltage signal required for a transparency display is a signal suitable for a color display, and a display voltage signal required for a reflective display is a signal suitable for monochrome display. For this reason, for example, although the rate which each pixel of R, G, and B contributes to lightness is proportional to the luminous transmittance (Y value) of each color in the transparency display 10, the trouble on drive of completely becoming equal by each pixel arises in the reflective display 9.
[0453] Although the lightness in consideration of luminous transmittance differs in the transparency display 10 by which color filter 61 R.61G and 61B have been arranged when it is got blocked, for example, the lightness of the display with the case where only the pixel of the case where only the pixel of B is clear display, and G is clear display is measured, it is the fault that lightness will become the same, in the reflective display 9 by which color filter 61 R.61G and 61B are not arranged.
[0454] The method of changing the area of the field which does not perform the color display of the reflective display 9 as an approach of preventing such fault, according to Y value of each color of R, G, and B of color filter 61 R.61G and 61B used for a transparency display for every pixel of R, G, and B is mentioned. The contribution to the lightness from monochrome display of the reflective display 9 in each pixel of R, G, and B can be adjusted by changing the area of the reflective display 9 by this, and the lightness of monochrome display based on the area of this reflective display 9 can be made to reflect in each color specification brightness.
[0455] Moreover, there is same effectiveness also by designing the color filter coverage of the reflective

display 9 so that it may become the order of G, R, and B from small order. According to this approach, there is also an advantage that some green coloring looked at by the further usual polarizing plate can be amended. Moreover, as shown in drawing 26 (a), when piling up and arranging a color filter substrate and a TFT component substrate, the location precision of the superposition of a TFT component substrate and a color filter substrate also has the advantage that it can take comparatively greatly. Since the color filter agenesis section of the reflective display 9 exists in the both sides of one pixel, this is for another side to decrease in number, when those either increases by location gap.

[0456] If the above TFT component substrates and a color filter substrate are used, when the transparency display is being performed According to concomitant use of the lighting system (back light) as a background lighting means, the same display as the TFT-liquid-crystal display of the conventional transparency display is attained. Furthermore, since the reflected light is performing the display near the contents of a display of a transparency display also when an ambient light is very strong, the color liquid crystal display of the high resolution which the check of the contents of a display is attained, does not have a washout even when an ambient light is strong, and does not have parallax is realizable.

[0457] Next, the configuration of a TFT component substrate and a color filter substrate is changed, the reflected light of an ambient light is used for a display, a main operating condition is used as a liquid crystal display with little power consumption, and only when the reinforcement of an ambient light is not enough, the substrate structure of the liquid crystal display of a reflective subject transflective type where a transparency display is used is explained below with reference to drawing 28 , drawing 29 (a), and drawing 29 (b).

[0458] Drawing 28 is the important section top view of the TFT component substrate for realizing the liquid crystal display of a reflective subject transflective type concerning the gestalt 7 of this operation, and shows the configuration of the TFT component substrate which made reflection the subject. In addition, in drawing 28 , a two-dot chain line shows the drive electrode 19.

[0459] As shown in drawing 28 , the liquid crystal display of the above-mentioned reflective subject transflective type has the same configuration as the liquid crystal display of said transparency subject transflective type except having set up smaller than it in the TFT component substrate used for the liquid crystal display of said transparency subject transflective type the magnitude of opening 19a for a transparency display in the drive electrode 19, and the magnitude of the transparence pixel electrode 20.

[0460] That is, as the pixel electrode 18 which drives the liquid-crystal layer 1 (refer to drawing 1 and drawing 4) is shown in drawing 28 , it is constituted by the transparence pixel electrode 20 which consists of the drive electrode 19 and ITO of the reflective display 9, and the above-mentioned drive electrode 19 and a transparence pixel electrode 20 are connected to the drain terminal 22 of the TFT component 21 which controls the electrical potential difference used for a display by each pixel unit also in the liquid crystal display of the above-mentioned reflective subject transflective type. Moreover, opening 19a for a transparency display is formed in the drive electrode 19, and when the above-mentioned drive electrode 19 is a reflector, this opening 19a formation field for a transparency display is used for a transparency display as a transparency display 10 (refer to drawing 24 , drawing 25 , and drawing 27).

[0461] Moreover, the TFT component 21, wiring 23 and wiring 24, the auxiliary part by volume 26, and the auxiliary capacity line 27 are arranged, and these components are arranged at the lower layer of the above-mentioned drive electrode 19 so that it may not be arranged in the above-mentioned opening 19a for a transparency display.

[0462] However, the TFT component substrate shown in drawing 28 has the rate of the transparency display 10 more smaller than the TFT component substrate used for the liquid crystal display of said transparency subject transflective type shown in drawing 2323 (a) - drawing 27 , and it is set up so that the rate of the reflective display 9 (refer to drawing 24 , drawing 2525 , and drawing 27) may become large.

[0463] Thus, with the gestalt of this operation, the area which can be used for a transparency display

produced the TFT component substrate with which the area which can be used for a reflective display occupies 70% of the whole pixel 13% of the area of the whole pixel as a TFT component substrate for the liquid crystal displays of a reflective subject transflective type.

[0464] The rate of the transparency display 10 in the TFT component substrate for the liquid crystal displays of the above-mentioned reflective subject transflective type is small as compared with 13% and the rate of the transparency display 10 in the TFT component substrate for the liquid crystal displays of said transparency subject transflective type. However, since the liquid crystal display of a reflective subject transflective type using this TFT component substrate can aim at reduction of power consumption by limit of the lighting time amount of the lighting system (back light) as a background lighting means when a reflective display performs a transparency display only within the case where the contents of a display cannot be checked, it can secure sufficient practicality.

[0465] Next, the configuration of the color filter substrate used combining this TFT component substrate is explained below with reference to drawing 29 (a) and drawing 29 (b).

[0466] As shown in drawing 29 (a) and drawing 29 (b), also to the color filter substrate for the liquid crystal displays of a reflective subject transflective type Like the color filter substrate for the liquid crystal displays of a transparency subject transflective type shown in drawing 26 (a) and drawing 26 (b) On a glass substrate 62, color filter 61 R.61G and 61B of three colors of red (R), green (G), and blue (B) are formed in the shape of a stripe. On color filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62 The smoothing layer 501 is formed with transparence acrylic resin so that these color filter 61 R.61G and 61B may be covered. On it as a counterelectrode 502 of a TFT component pixel electrode ITO is formed by sputtering using the wrap electric shielding mask except the predetermined field.

[0467] However, the color filter substrate for the liquid crystal displays of a reflective subject transflective type shown in drawing 29 (a) and drawing 29 (b) is set up so that the flat-surface configuration of color filter 61 R.61G and 61B and the spectral transmittance for every color may differ from the color filter substrate for the liquid crystal displays of a transparency subject transflective type shown in drawing 26 (a) and drawing 26 (b).

[0468] Specifically in the color filter substrate for the liquid crystal displays of a reflective subject transflective type Color filter 61 R.61G and 61B are formed so that the reflective display 9 of a TFT component substrate may be altogether covered by color filter 61 R.61G and 61B (coloring layer). And this color filter 61 R.61G and 61B By the reflective display 9, it is produced whenever [Takaaki] so that display light may pass color filter 61 R.61G and 61B twice and may become good lightness in consideration of display light passing color filter 61 R.61G and 61B twice, so that a good display may be shown in a reflective display.

[0469] For this reason, in the reflective display 9, as mentioned above, a good reflective display is realized with the combination of a TFT component substrate with the large rate of the reflective display 9, and the color filter substrate set by it as mentioned above.

[0470] Moreover, although the rate of opening 19a for a transparency display is small in the transparency display 10, also in the transparency display used only within the case where an ambient light is inadequate, the contents of a display can be checked according to concomitant use of the lighting system (back light) as a background lighting means. The liquid crystal display of a reflective subject transflective type applied to the gestalt of this operation at this point differs from the conventional reflective mold liquid crystal display. Although the liquid crystal display of a reflective subject transflective type concerning the gestalt of this operation has inadequate saturation when color filter 61 R.61G and 61B adjusted to the reflective display perform a transparency display, the check of a foreground color is possible.

[0471] When the liquid crystal display of the above-mentioned reflective subject transflective type performs color display, so, to each pixel Color filter 61 R.61G and 61B are allotted to a reflective display at least, and color display is performed. To the transparency display 10 Especially the thing for which

color filter 61 R.61G and 61B which has the saturation more than color filter 61 R.61G and 61B allotted to the reflective display 9 at a part of transparency display [at least] 10, and an EQC, not using color filter 61 R.61G and 61B are allotted is effective.

[0472] Thus, with the liquid crystal display of the above-mentioned reflective subject transflective type, color filter 61 R.61G and 61B are formed in a reflective display at least, and the transparency display 10 is good also as a configuration which has the field (part) in which color filter 61 R.61G and 61B are not prepared, and may perform monochrome display to the transparency display 10 by the transparency display 10, without using color filter 61 R.61G and 61B. Since the permeability of light rises in the case of the latter, it is possible to set up the transparency display 10 still smaller. Thereby, the area of the reflective display 9 can be secured more greatly and a better display can usually be obtained in the reflective display at the time of use.

[0473] In this case, like the liquid crystal display of a transparency subject transflective type, also in the liquid crystal display of the above-mentioned reflective subject transflective type, the area of the display which does not perform a color display, i.e., the area of a field which does not perform the color display of the transparency display 10 in this case, may be doubled with Y value of each color of R, G, and B of color filter 61 R.61G and 61B, and it may be changed for every pixel of R, G, and B. That is, in order to set up the contribution to the lightness of monochrome display of the transparency display 10 in each pixel of R, G, and B proper in consideration of luminous transmittance, each above-mentioned substrate may be produced so that the rates of a transparency screen product may differ for every pixel of R, G, and B.

[0474] On the other hand, it is strengthening the illumination light of this lighting system (back light) enough, although the power consumption at the time of lighting-system (back light) lighting as a background lighting means increases, and it is also possible to use the color filter of high saturation set by the transparency display 10 at the transparency display. In this case, not only saturation but the color reproduction nature of a transparency display is also securable. It is important to make lighting time amount of the above-mentioned lighting system (back light) into the minimum in the case of which in order to reduce power consumption.

[0475] As mentioned above, according to the gestalt of this operation, while power consumption is reducible in anticipated use, the liquid crystal display of a reflective subject transflective type which cannot start a washout by the reflective display 9, and can perform the transparency display using a background lighting means (back light) if needed is realizable.

[0476] In addition, although the amorphous silicon TFT component of a bottom gate mold was mentioned as the example and explained as this TFT component 21 by the above-mentioned explanation while using the TFT component 21 as a switching element of an active matrix, especially as the above-mentioned switching element used in the gestalt of this operation, it may not be limited to this and you may be the MIM (Metal Insulator Metal) component which are a poly-Si TFT component and 2 terminal component. Moreover, it cannot be overemphasized that it is not necessary to necessarily use these active components.

[0477] Moreover, in each liquid crystal display concerning the gestalt of this operation, as mentioned above, only the thickness of an organic compound insulator 25 can change liquid crystal thickness by the reflective display 9 and the transparency display 10 by using the TFT component substrate which has the structure which separated the drive electrode 19 which is an electrode for a display, and wiring 23-24 by the organic compound insulator 25. And in these liquid crystal displays, even if it sets the thickness of the above-mentioned organic compound insulator 25 as the value of about 3 micrometers whose high capacity display is attained from wiring resistance of a TFT component substrate, and the point of parasitic capacitance, as shown in the gestalten 1 and 2 of said operation, realizing a good display by both the above-mentioned reflective display 9 and the transparency display 10 can acquire a liquid crystal thickness difference possible enough.

[0478] Therefore, the liquid crystal display in which a high capacity display is possible is realizable by

adopting the TFT component substrate which has the structure indicated to drawing 23 (a) or drawing 28 , and a liquid crystal display method given in the gestalten 1 or 2 of operation.
[0479] Furthermore, the TFT component substrate of structure using the organic compound insulator 25 which was mentioned above is already put in practical use in part in the liquid crystal display of the usual TFT component drive method of only a transparency display, a mass-production top also has few technical technical problems, and its practicality is high.
[0480] In addition, in the reflective mold liquid crystal display, invention-in-this-application persons are the purposes, such as mirror plane-ized prevention of the screen, gave smooth irregularity to the reflective film and have repeated examination on it about production of the reflective film of a good reflection property. Consequently, also in the organic compound insulator 25 used in this invention, irregularity is formed in the part corresponding to the reflective display 9 in the TFT component substrate for the liquid crystal displays of a transparency subject transflective type which finds out that production of the same concave convex is possible, and shows it to drawing 23 (a) - drawing 27 .
[0481] As mentioned above, with the gestalt of this operation, there are two kinds of use gestalten of a transparency subject transflective type and a reflective subject transflective type in the use gestalt of a liquid crystal display, and it explained that the designs of the color of the ratio of the screen product of a transparency display and a reflective display and the color filter in the case of color display differed, respectively by whether a main display is performed by transparency display, or it carries out by reflective display.
[0482] So, the gestalt 8 of the following operations explains the ratio of the transparency display and reflective display in the liquid crystal display concerning this invention.
[0483] [Gestalt 8 of operation] The ratio of a transparency display and a reflective display needs to be set up in consideration of visibility. the brightness (consciousness lightness) in consideration of the adaptation phenomenon of people's vision perceived by vision -- Stevens Etc. ("Brightness Function : Effect of Adaptation", Journalof the Optical Society of America, Vol.53, No.3, p375) etc. It is investigated. According to this reference, even if human being's eyes are the times of seeing the thing of the same brightness, depending on the brightness to which the brightness perceived has adapted itself, it turns out that there is quantity-relation to there.
[0484] drawing 30 -- Stevens etc. -- the relation between the adaptation luminance which gives the consciousness lightness of the equivalence to 5bril which changed and produced the unit from reference - 45bril, and sample brightness is shown. In drawing 30 , as for an axis of abscissa, those who will observe a sample from now on show the adaptation luminance (unit: cd/m2) which has adapted itself by then, and the axis of ordinate shows the brightness (sample brightness (unit: cd/m2)) of the sample which the man was shown.
[0485] Setting to drawing 30 , Point A is 1 cd/m2. The persons adapting to adaptation luminance are 10 cd/m2. It is the consciousness lightness when observing the sample which has a brightness side, and Point B is 1700 cd/m2. The persons adapting to adaptation luminance are 300 cd/m2. The consciousness lightness when observing the sample which has a brightness side is expressed. Since both consciousness lightness is the same values (9.4bril) at Point A and Point B, drawing 30 shows that people's consciousness-lightness is influenced by not only the brightness of the screen but adaptation luminance.
[0486] Then, adaptation of the observer of the screen of a liquid crystal display is considered below. First, the object to which an observer adapts himself is considered. When people observe a certain object and adapt themselves to the brightness of that object, that object that adapts itself is the brightness of the front face of the object set as the check-by-looking object around visual environment, and, generally it depends for the brightness of the front face of the object used as this candidate for a check by looking on various environmental conditions. However, it is useful to assume that the candidate for adaptation is taken into consideration, i.e., the reflector in which the front face of an observation object reflects an ambient light; as one index, and to take this case into consideration. It is because it is

natural to think that there is than the situation that the situation which people look at the light source itself which is emitting light, and adapts itself to it adapts itself to the reflector of the object illuminated by that light source even if this reason is the interior of a room and it is the outdoors. [few] Hereafter, adaptation of an observer who is accommodating vision to the reflector of an observation object is considered.

[0487] When the brightness side of an observation object is a reflector, adaptation luminance given in drawing 30 is shown by the value which multiplied the illuminance in the object side by the source of the illumination light which illuminates the object side where an observer adapts himself by the fixed value. When an illuminance is set to L (unit: lux (lux)) and brightness is set to B (unit: cd/m2), the brightness (B) of the field where the reflection factor to a perfect reflecting diffuser has the reflection factor of R serves as B=LxR/pi. Here, it is appropriate to take into consideration the brightness of the field of Munsell color charts N5 illuminated by a certain illuminance using the reflection factor of the field of Munsell color charts N5 said to have the average reflection factor for [of the usual human being] observation as adaptation luminance. In this case, R is set to 0.2.

[0488] Furthermore, it is assumed that not only the field of Munsell color charts N5 for adaptation but the object sample side where consciousness lightness is evaluated under the adaptation condition is illuminating to coincidence the source of the illumination light which is illuminating the field of Munsell color charts N5 which are the representation for observation. It is connected with the illuminance to which the consciousness lightness of the reflective display in the case of observing a liquid crystal display illuminates that liquid crystal display through adaptation luminance by this assumption. By this, concrete selection of the rate of a reflection factor and the area of a reflective display is attained based on the data of a mental physics experiment.

[0489] According to an invention-in-this-application person's etc. examination, the concrete standard of consciousness lightness can be put in another way to lightness as shown in Table 9. This actually reproduces some combination of adaptation luminance and sample brightness, results in the conclusion that such a lightness expression is appropriate, and serves as a scale of a setup of the reflective display by consciousness lightness.

[0490]

[Table 9]

[0491] Here, since the typical reflection factor (R) of a reflective mold liquid crystal display becomes about 30% by the polarizing plate method, this numeric value is used and actuation of the transflective type liquid crystal display concerning this invention is explained.

[0492] The straight line 601 given in drawing 30 shows actuation of a display of the liquid crystal display of 30% of reflection factors. That is, when the illuminance of the source of the illumination light which illuminates the brightness side where an observer adapts himself is set to L (unit: lux), since the adaptation luminance by the field of Munsell color charts N5 requires the reflection factor (R= 20%) of the field of these Munsell color charts N5 for the brightness (L/pi) of the perfect reflecting diffuser illuminated by the same lighting, it serves as 0.2x L/pi. Similarly, the sample brightness of the screen of

the liquid crystal display (object sample) whose reflection factor illuminated by the same lighting is 30% serves as 0.3x L/pi. That is, the straight line which plotted respectively the point of having changed an illuminance (L) variously and filling the relation of axis-of-abscissa 0.2 L/pi and axis-of-ordinate 0.3 L/pi, and was obtained is a straight line 601. Moreover, the straight line which plotted respectively the point of filling the relation of axis-of-abscissa 0.2 L/pi and axis-of-ordinate 0.1 L/pi by making into an object sample the liquid crystal display which has 10% of reflection factor like the case where the above-mentioned liquid crystal display which has 30% of reflection factor is made into an object sample, and was obtained is a straight line 602.

[0493] Next, the usable environment of the above-mentioned liquid crystal display where it has 30% of reflection factor is considered below. The adaptation luminance according [on the illuminance (about 100,000 luxs) of the direct light at the time of the fine weather which is the brightest lighting conditions that people experience in everyday life, and] to the field of Munsell color charts N5 is about 6000 cd/m2. It becomes. At this time, the consciousness lightness of the screen of a liquid crystal display which has 30% of reflection factor is adaptation luminance 6000 cd/m2, as shown in drawing 30. As it is set to about 30 bril(s) which are the consciousness lightness in the intersection of the straight line 605 and straight line 602 which are shown and was shown in Table 9, it is the value which senses dazzle. Moreover, the consciousness lightness under lighting darker than this is a value lower than the above-mentioned consciousness lightness, and the illuminance which can secure consciousness lightness 10bril becomes about 450 luxs by counting backward the formula mentioned above using the numeric value of the corresponding adaptation luminance. That is, although 450 luxs and the maximum illuminance become 100,000 luxs and the above-mentioned liquid crystal display has the usable minimum illuminance in the interior of a room (for example, interior of a room which attached lighting 450 luxs or more) used as the outdoors of the usual daytime, and the illuminance of 450 luxs or more when you need the clear display of 10 or more brils and 30 brils or less temporarily, a dark place is not enough as an illuminance and it becomes difficult from it to perceive it in it.

[0494] Moreover, a straight line 603 (drawing 30) shows the relation between the adaptation luminance when making a reflection factor into 50%, and sample brightness. When a reflective display is realized with 50% or more of reflection factor, under high illuminance environments (for example, the interior of a room of a bright place by the window, direct-rays Shimo, etc.) 1800 luxs or more, consciousness lightness will exceed 30bril(s) like the paper of the usual white, so that this straight line 603 may show. This shows what white paper senses dazzling in such an environment. Therefore, it is unsuitable from the point of visibility to use the screen which has 50% or more of reflection factor in this way under a high illuminance environment, and when performing a reflective display under such an environment, the reflection factor of the screen (brightness side) is understood that it is desirable that it is about 30%.

[0495] On the other hand, the illuminances which are shown in a straight line 601-602 and which give the consciousness lightness of 10bril in a reflective display at 30% of reflection factors and a reflective display at 10% of reflection factors are about 450 luxs and 3000 luxs respectively. That is, if a reflection factor is set to one third, it will be necessary to give 6.7 times brighter lighting. This shows that people's eyes will need to adapt themselves to bright reflectors other than a liquid crystal display, and will need to strengthen lighting more than the inverse number of the change ratio of a reflection factor, if lighting is strengthened, since the reflection factor of a liquid crystal display fell.

[0496] Furthermore, the display in the display object (for example, common luminescence mold display) which has fixed brightness has the trouble of sensing very dark especially in being bright in a perimeter so that drawing 30 may show.

[0497] However, in the transflective type liquid crystal display concerning this invention, the sum of the fixed brightness determined with the background illumination light and permeability in a transparency display and the brightness (sample brightness) determined with the fixed reflection factor in a reflective display is used for a display. That is, in the transflective type liquid crystal display concerning this invention, the display by the display brightness shown in the curve 604 shown in drawing 30, for example

is realized. With the transflective type liquid crystal display concerning this invention, visibility is secured by reflective display, and as shown in this curve 604, when the illuminance of lighting is high, when the illuminance of lighting is low, visibility can be secured by the transparency display which used the lighting system (back light) as a background lighting means.

[0498] Furthermore, the result of having changed the illuminance using the display brightness of the transflective type above-mentioned liquid crystal display, and having searched for consciousness lightness is shown in drawing 31. Moreover, the relation of the illuminance and consciousness lightness in the liquid crystal display of a reflective mold is collectively shown in the relation of the illuminance and consciousness lightness in the liquid crystal display of a transparency mold, and a list as a comparison at drawing 31. Here, the illuminance in the field where, as for count of the above-mentioned consciousness lightness, 2000 cd/m2 and an observer have adapted [transmission / in case 30% and all viewing areas are transparency color displays about a reflection factor in case all viewing areas are reflective color displays] themselves in 7.5% and back light brightness was equal to the illuminance in the screen of a liquid crystal display, and the reflection factor of the field for adaptation was made into 20% supposing the lightness of Munsell color charts N5.

[0499] In drawing 31, the value of the consciousness lightness when changing an illuminance changes with rates (Sr) of the reflective display of the field in the transflective type above-mentioned liquid crystal display which can be displayed. A curve 611 shows the relation of the illuminance and consciousness lightness in Sr=0, i.e., the usual transparency mold liquid crystal display which does not perform a reflective display only by transparency display. the brightness of the screen in this transparency mold liquid crystal display -- 150 cd/m2 it is -- consciousness lightness is set to 10 or less brils when an illuminance is about 6000 luxs or more. Therefore, in order to secure the consciousness lightness of 10 or more brils by changing a part of transparency display into a reflective display, as shown in a curve 612, it is necessary to make into a reflective display 1/1 [Sr=0.], 10 [i.e.,] of the field which can be displayed, of area.

[0500] Moreover, a curve 613 is a curve which shows the relation of the illuminance and consciousness lightness in Sr=1, i.e., the reflective mold liquid crystal display which performs only a reflective display. The reflection factor of the screen of this reflective mold liquid crystal display is 30% in the comparison with a perfect reflecting diffuser, and consciousness lightness is set to 10 or less brils when an illuminance is about 450 luxs or less. Therefore, in order to secure the consciousness lightness of 10 or more brils by changing a part of reflective display into a transparency display, as shown in a curve 614, it is necessary to prepare Sr=0.9, i.e., 1/10 of the field which can be displayed of the transparency displays of area.

[0501] Moreover, while it turns out in the Sr values 0.1-0.9 that consciousness lightness can perform the good display of 10 or more brils and less than 30 brils according to drawing 31, when Above Sr is set as 0.30 (curve 615) or 0.50 (curve 616), it turns out that consciousness lightness can perform the bright good display of 20 or more brils and less than 30 brils.

[0502] Moreover, surface reflection arises on the surface of a liquid crystal display. The operation of the display active jamming by this surface reflection is so remarkable that a surrounding illuminance is large. The relation of the consciousness lightness and the illuminance by this surface reflection is collectively shown in above-mentioned drawing 31 (curve 617). Although surface reflection is greatly influenced by surface treatment, it shows the relation between the consciousness lightness of the field when the surface reflection produced in the interface of the medium of a refractive index 1.5 and air has the same diffusibility as the perfect diffuse surface (namely, when the reflection factor by surface reflection is 4%), and an illuminance with a curve 617. Therefore, if surface reflection is taken into consideration, it is desirable [the area of a reflective display] that it is 30% or more (namely, Sr>=0.3) of the sum of the area of a reflective display and the area of a transparency display, when performing a better display.

[0503] When performing a color display by both the reflective display and the transparency display according to the above analysis according to the gestalt of this operation, and the percentages of the

area of the reflective display in the sum of the area of a reflective display and the area of a transparency display are 30% or more and 90% or less, it turns out that a good display can be performed.

[0504] In addition, although it is possible to analyze the rate of the area of each display for performing a good display by the approach mentioned above and the same approach also when not using color display at least for one side among a reflective display and a transparency display A good display can be realized when it is within limits which the rate of the area of the reflective display which can be set mentioned above also in any sum of the area of a reflective display, and the area of a transparency display or case. In addition, as for the rate of the area of the reflective display in the sum of the area of a reflective display, and the area of a transparency display, the liquid crystal display of a transparency subject transflective type of a publication and the liquid crystal display of a reflective subject transflective type are produced by the gestalt 7 of the above-mentioned operation at a rate that the above is desirable.

[0505] [Gestalt 9 of operation] Although the gestalt of this operation more specifically gives and explains a concrete example about the liquid crystal display of the active-matrix mold using a liquid crystal display method given in the gestalt 1 of said operation, and the gestalt 2 of operation, and the liquid crystal display which realized color display using the TFT component substrate, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0506] The making process of the liquid crystal display of the above-mentioned active-matrix mold concerning the gestalt of this operation consists of the process which produces a TFT component substrate, the process which produces a color filter substrate, a process which produces the liquid crystal cell for liquid crystal impregnation using these TFT(s) component substrate and a color filter substrate, and a process which injects liquid crystal into the obtained liquid crystal cell for liquid crystal impregnation, and is assembled as a liquid crystal display.

[0507] Then, the manufacture approach of the liquid crystal display of the active-matrix mold applied to each following example in the gestalt of this operation is first explained sequentially from the making process of the above-mentioned TFT component substrate.

[0508] The TFT component substrate has the configuration the TFT component 21 was formed for every pixel of whose process shown below on the substrate 29 which has translucency, as shown in drawing 23 (a) - drawing 25.

[0509] The glass substrate which consists of alkali free glass which does not contain an alkali component as the above-mentioned substrate 29 which forms the above-mentioned TFT component 21 was used. First, wiring 23 and the auxiliary capacity line 27 were formed on this substrate 29 by forming membranes by sputtering and carrying out patterning of the tantalum used as wiring 23 and the auxiliary capacity line 27 as gate wiring further. At this time, the open circuit is prevented by carrying out patterning of these wiring 23 and the auxiliary capacity line 27 so that the level difference of each wiring (wiring 23, auxiliary capacity line 27) may become gently-sloping, and making good covering nature of the below-mentioned wiring 24 formed after these wiring.

[0510] Furthermore, the tantalum oxide (Ta 2O5) layer was formed in the above-mentioned wiring 23 and the auxiliary capacity line 27 according to the anodic oxidation process, and the silicon nitride which serves as gate dielectric film on it was formed on them. furthermore, the chemical vapor deposition (CVD) which used mono-silane gas for the hydrogenation amorphous silicon layer as an intrinsic-semiconductor layer (i layers) and the silicon nitride layer as an etching stopper layer used as the switching field of the TFT component 21 on it at this order -- it formed by law and sputtering (silicon nitride). Next, n+ which becomes the source terminal 28 of the TFT component 21, and the drain terminal 22 by CVD using the mono-silane gas which mixed phosphoretted hydrogen gas after carrying out patterning of the silicon nitride layer as an etching stopper layer of the maximum upper layer The layer was formed. Subsequently, above-mentioned n+ Patterning of a layer and the i layers was carried out, and patterning of gate dielectric film was performed further. At this time, the silicon nitride for a connection terminal area of the viewing-area exterior in wiring 23 (gate wiring) was removed collectively.

[0511] Next, ITO used as the transparence pixel electrode 20 was formed by sputtering so that the source terminal 28 and the drain terminal 22 might be contacted, and the tantalum used as the wiring 24 as source wiring was further formed by sputtering. Patterning of this tantalum was carried out, it considered as wiring 24, patterning of the ITO film currently formed by that lower layer was carried out further, and the transparence pixel electrode 20 was formed. This transparence pixel electrode 20 is in contact with the source terminal 28 and the drain terminal 22, as mentioned above, and the role which forms the ohmic contact of these terminals (source terminal 28, drain terminal 22) and wiring 23-24 is also played.
[0512] Next, the organic compound insulator 25 which has concavo-convex structure on a front face is formed as an insulator layer for reflective displays on the above-mentioned TFT component 21. The aluminum which serves as the drive electrode 19 of the reflective display 9 so that the transparence pixel electrode 20 may be touched in the contact hole used as opening for a transparency display prepared in this organic compound insulator 25 is formed by sputtering. By carrying out patterning of the obtained aluminum film by dry etching, the drive electrode 19 as a reflector which has the concavo-convex structure of the organic-compound-insulator 25 above-mentioned front face and the same concavo-convex structure was formed.
[0513] In each above-mentioned patterning process, each component is formed in the required configuration based on a design by the technique of photolithography. It used for these photolithography process combining sensitization resin film (resist) spreading / desiccation process, a pattern exposure process, the development process, the resist baking hardening process, a dry etching process and a wet etching process, and the resist exfoliation removal process.
[0514] Moreover, the concavo-convex structure formed in the reflective display 9 applied the insulating photopolymerization nature resin ingredient, and produced it using a pattern exposure process, a development process, and hardening down stream processing. That is, while the dot-like pattern was formed at the development process, the smoothing layer was formed with the still more nearly same ingredient on this dot pattern. In addition, the above-mentioned organic insulating layer 25 is not formed in the transparency display 10.
[0515] The TFT component 21 is allotted to each pixel by the TFT component substrate produced at the above processes, and each pixel is constituted from a reflective display 9 and a transparency display 10. as the TFT component substrate having produced two kinds of TFT component substrates shown in the TFT component substrate shown in drawing 23 (a), and drawing 28 here, and explanation of each liquid crystal display having indicated the rate of the transparency display 10 and reflective display 9 in the gestalt 7 of said operation -- comparatively -- having carried out .
[0516] Next, the making process of a color filter substrate is explained. The making process of a color filter substrate is a substrate from the process which forms the transparence pixel electrode 20 by the side of the TFT component substrate driven by said TFT component 21 on the process which produces the coloring layer (color filter) of R, G, and B, the process which produces a flattening layer on this color filter, and this flattening layer, and the counterelectrode which counters.
[0517] In the gestalt of this operation the above-mentioned color filter substrate As shown in drawing 26 (b) or drawing 29 (b), on a glass substrate 62 Color filter 61 R.61G and 61B of three colors of red (R), green (G), and blue (B) are formed in the shape of a stripe. It produced by forming the smoothing layer 501 on color filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62, so that these color filter 61 R.61G and 61B may be covered, and forming a counterelectrode 502 on it.
[0518] In formation of the above-mentioned color filter substrate, color filter 61 R.61G and 61B carried out patterning of the resin ingredient which made the optical photopolymer distribute a pigment by the photolithography method, and formed it. In addition, as the manufacture approach of of this color filter 61 R.61G and 61B, approaches other than the approach using distribution of the above-mentioned pigment, for example, an electrodeposition process, a film replica method, a staining technique, etc. can be adopted, and it is not limited especially.

[0519] On color filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62, the flattening layer 501 applied acrylate resin with high light transmittance, was made to harden it with heat, and was formed. Moreover, the counterelectrode 502 formed on this flattening layer 501 was a counterelectrode which counters the pixel electrode 18 driven by the TFT component 21, made ITO deposit through a mask by sputtering as a transparent electrode, and was formed by considering as a required flat-surface configuration.
[0520] With the gestalt of this operation, the above-mentioned color filter substrate produced two kinds such as the color filter substrate which set up saturation highly to compensate for the transparency display, and the color filter substrate which set up lightness highly to compensate for the reflective display. And the color filter substrate which set up saturation highly was produced to the pattern shown in drawing 26 (a) and drawing 26 (b), and the color filter substrate which set up lightness highly was produced to the pattern shown in drawing 29 (a) and drawing 29 (b).
[0521] Next, in order to produce a liquid crystal display using the TFT component substrate and color filter substrate which were produced as mentioned above, the process which is made to carry out opposite arrangement of these TFT(s) component substrate and the color filter substrate, and produces the liquid crystal cell for liquid crystal impregnation is explained.
[0522] In this process, first, the fusibility polyimide solution has been arranged to the liquid crystal display field in the mutual opposed face (TFT component 21 forming face in the above-mentioned TFT component substrate, and color filter 61 R.61G and 61B forming face in a color filter substrate) in a TFT component substrate and a color filter substrate with offset printing, and the orientation film was formed in it through desiccation and a baking process. Furthermore, orientation processing which decides the direction of liquid crystal orientation to be this orientation film was performed by the rubbing method. In addition, whether the orientation film is an parallel stacking tendency or it is a perpendicular stacking tendency change with each examples mentioned later.
[0523] Then, while printing the enclosure sealing compound for fixing the above-mentioned TFT component substrate and a color filter substrate while sprinkling the spherical spacer to which particle size was equal to either the TFT component substrate processed in this way or a color filter substrate and enclosing a liquid crystal layer with it on another side, the conductive paste which takes the flow of a counterelectrode 502 from a TFT component substrate side to a color filter substrate side has been arranged.
[0524] And opposite arrangement of TFT component 21 forming face in the above-mentioned TFT component substrate, and color filter 61 R.61G and 61B forming face in a color filter substrate was carried out, alignment of both substrates (a TFT component substrate and color filter substrate) was performed, and the enclosure sealing compound and the ******-strike were stiffened under pressurization.
[0525] According to the above process, the mother glass substrate 21 by which two or more arrangement was carried out was produced, and further, the liquid crystal cell for liquid crystal impregnation divided this mother glass substrate, and produced the cel for liquid crystal impregnation.
[0526] Then, the liquid crystal cell was produced by applying photopolymerization nature resin in a liquid crystal inlet, and carrying out polymerization hardening by ultraviolet radiation so that the liquid crystal layer which introduced the liquid crystal constituent and was introduced may not touch the above-mentioned liquid crystal non-poured in liquid crystal cell with the open air by the vacuum pouring-in method.
[0527] Next, the short ring part arranged at the TFT component substrate edge was removed so that each wiring terminal might be short-circuited for the purpose of electrostatic-discharge prevention of the TFT component 21, and the external circuit which drives the TFT component 21 was connected. Furthermore, the liquid crystal display of the active-matrix mold which arranges the back light used as the light source of a transparency display, and is applied to the gestalt of this operation was produced.
[0528] [Example 14] The liquid crystal display of the active-matrix mold concerning this example is a

liquid crystal display of a transparency subject transflective type which used GH method, and is a liquid crystal display which used GH method in the example 1 of the gestalt 1 of said operation for the display.
[0529] The liquid crystal constituent used for this example is prepared according to the example 1 of the gestalt 1 of said operation. That is, in this example, the liquid crystal constituent using the dichroism coloring matter (dichroism coloring matter 12) of a publication was used for said example 1. Moreover, in this example, using the perpendicular orientation film which has a perpendicular stacking tendency on the orientation film, orientation processing by rubbing was performed so that uniform perpendicular orientation might be obtained. In addition, in this example, since GH method which used dichroism coloring matter for the liquid crystal constituent is adopted, the phase contrast compensating plate and the polarizing plate have not been stuck on the above-mentioned liquid crystal cell.
[0530] Moreover, in this example, in order to mainly use a transparency display, color filter 61 R.61G and 61B designed saturation highly like the color filter of the conventional transparency means of displaying, and the color filter substrate has been arranged, as shown in drawing 26 (a) and drawing 26 (b). The TFT component substrate combined with this color filter substrate had large opening 19a for a transparency display, as shown in drawing 23 (a), and the TFT component substrate with which the transparency display 10 was set up widely was used for it.
[0531] In the above-mentioned liquid crystal display concerning this example, as shown in drawing 26 (a) and drawing 26 (b), the drive electrode 19 in the reflective display 9 Only the part (part which counters with color filter 61 R.61G and 61B in the extension direction of color filter 61 R.61G and 61B in the drive electrode 19) It is covered with the same color filter 61 R.61G and 61B as the opening 19a formation field for a transparency display used as the transparency display 10, there is no color filter, and it also has a part for the display which passes the white light.
[0532] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, lighting of a back light was always required of this example. However, when [both] a back light was turned on, lightness and a contrast ratio were good and always sufficient display was possible. Moreover, a check by looking of the contents of a display is possible also under direct rays, and the washout was not produced.
[0533] That is, the color liquid crystal display of the high resolution which the washout which the check of the contents of a display is attained since the reflective display 9 changes lightness in proportion to [when an ambient light is strong] an ambient light while a liquid crystal display with high lightness is realized with a back light like the transparency mold liquid crystal display conventional in the environment where it is [of an ambient light] weak in this example, and is produced with a conventional luminescence display and transparency mold liquid crystal display does not arise, and does not have parallax is realizable. Moreover, in this example, the very good reflective display without parallax (twin image) was realized.
[0534] [Example 15] The liquid crystal display of the active-matrix mold concerning this example is a liquid crystal display of a reflective subject transflective type which used GH method, and is a liquid crystal display which used GH method in the example 1 of the gestalt 1 of said operation for the display.
[0535] The liquid crystal constituent is prepared like [this example] the above-mentioned example 14 according to the example 1 of the gestalt 1 of said operation. That is, the liquid crystal constituent using the dichroism coloring matter (dichroism coloring matter 12) of a publication was used for said example 1 also by this example. Moreover, in this example, using the perpendicular orientation film which has a perpendicular stacking tendency on the orientation film, orientation processing by rubbing was performed so that uniform perpendicular orientation might be obtained. In addition, in this example, since GH method which used dichroism coloring matter for the liquid crystal constituent is adopted, the phase contrast compensating plate and the polarizing plate have not been stuck on the above-mentioned liquid crystal cell.
[0536] Moreover, in this example, in order to mainly use a reflective display, color filter 61 R.61G and 61B were produced so that it might become whenever [Takaaki] from the color filter used for the

conventional transparency mold liquid crystal display, and the color filter substrate has been arranged, as shown in drawing 29 (a) and drawing 29 (b). The TFT component substrate combined with this color filter substrate had small opening 19a for a transparency display, as shown in drawing 28, and the TFT component substrate with which the reflective display 9 was set up greatly was used for it.
[0537] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, the above-mentioned liquid crystal display concerning this example of lighting of a back light was unnecessary under lighting and an outdoor daylight environment in the daytime, and the reflective display was possible. In this example, the very good reflective display without parallax (twin image) was realized. Moreover, the check by looking of the contents of a display was possible by turning on a back light to extent in which observation by the reflected light is impossible, when an ambient light is dark.
[0538] That is, in this example, since color filter 61R.61G, 61B, and the color filter substrate which were set by the reflective display are used as mentioned above, the color display only by the reflected light is possible. For this reason, it is possible to switch off a back light and to use it only by reflective display on the outdoors of the usual indoor lighting or daytime. Moreover, by turning on a back light if needed, even when lighting is dark, visibility can be secured.
[0539] In the liquid crystal display concerning the gestalt of this operation, while having not always turned on the back light and being able to reduce power consumption like the conventional transparency mold liquid crystal display, a washout cannot be started by the reflective display 9, and the transparency display using a back light can be performed if needed.
[0540] [Example 16] The liquid crystal display of the active-matrix mold concerning this example is a liquid crystal display of a transparency subject transflective type which used the polarization conversion operation of a liquid crystal layer for the display, and is a liquid crystal display which used the polarizing plate method in the example 5 of the gestalt 2 of said operation for the display.
[0541] The liquid crystal constituent used for this example is prepared according to the example 5 of the gestalt 2 of said operation. Moreover, in this example, the phase contrast compensating plate (phase contrast compensating plate 16-17) and the polarizing plate (polarizing plate 14-15) were stuck on the liquid crystal cell (TFT-liquid-crystal panel) into which liquid crystal was injected. Furthermore, in this example, by the rubbing method, orientation processing was performed on the orientation film of an parallel stacking tendency so that a rubbing crossed axes angle might become 250 degrees.
[0542] Moreover, in this example, like said example 14, in order to mainly use a transparency display, color filter 61 R.61G and 61B were designed in the same transparency color as the color filter of the conventional transparency means of displaying, and the color filter substrate has been arranged, as shown in drawing 26 (a) and drawing 26 (b). The TFT component substrate combined with this color filter substrate had large opening 19a for a transparency display, as shown in drawing 23 (a), and the TFT component substrate with which the transparency display 10 was set up widely was used for it.
[0543] As shown in drawing 26 (a) and drawing 26 (b), in the above-mentioned liquid crystal display concerning this example the drive electrode 19 of the reflective display 9 Only the part (part which counters with color filter 61 R.61G and 61B in the extension direction of color filter 61 R.61G and 61B in the drive electrode 19) It is covered with the same color filter 61 R.61G and 61B as the opening 19a formation field for a transparency display used as the transparency display 10, there is no color filter, and it also has a part for the display in which the white light is reflected.
[0544] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, lighting of a back light was always required of this example. However, when [both] a back light was turned on, lightness and a contrast ratio were good and always sufficient display was possible. Moreover, a check by looking of the contents of a display is possible also under direct rays, and the washout was not produced.
[0545] That is, at this example, in the weak environment of an ambient light, in order that the reflective display 9 may change lightness in proportion to an ambient light when an ambient light is strong while a

liquid crystal display with high lightness is realized with a back light like the conventional transparency mold liquid crystal display, the check of the contents of a display is attained and it turns out that the washout produced with a conventional luminescence display and a conventional transparency mold liquid crystal display does not arise. Moreover, in this example, the very good reflective display without parallax (twin image) was realized.
[0546] [Example 17] The liquid crystal display of the active-matrix mold concerning this example is a liquid crystal display of a reflective subject transflective type which used the polarization conversion operation of a liquid crystal layer for the display, and is a liquid crystal display which used the polarizing plate method in the example 5 of the gestalt 2 of said operation for the display.
[0547] The liquid crystal constituent is prepared like [this example] the above-mentioned example 16 according to the example 5 of the gestalt 2 of said operation. Moreover, this example also stuck the phase contrast compensating plate (phase contrast compensating plate 16-17; example 5 reference) and the polarizing plate (polarizing plate 14-15) on the liquid crystal cell (TFT-liquid-crystal panel) into which liquid crystal was injected. In this example, by the rubbing method, orientation processing was performed on the orientation film of an parallel stacking tendency so that a rubbing crossed axes angle might become 250 degrees.
[0548] Moreover, in this example, like said example 15, in order to mainly use a reflective display, color filter 61 R.61G and 61B were produced so that it might become whenever [Takaaki] from the color filter used for the conventional transparency mold liquid crystal display, and the color filter substrate has been arranged, as shown in drawing 29 (a) and drawing 29 (b). The TFT component substrate combined with this color filter substrate had small opening 19a for a transparency display, as shown in drawing 28, and the TFT component substrate with which the reflective display 9 was set up greatly was used for it.
[0549] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, the above-mentioned liquid crystal display concerning this example of lighting of a back light was unnecessary under lighting and an outdoor daylight environment in the daytime, and the reflective display was possible. In this example, the very good reflective display without parallax (twin image) was realized. Moreover, the check by looking of the contents of a display was possible by turning on a back light to extent in which observation by the reflected light is impossible, when an ambient light is dark.
[0550] That is, in this example, since color filter 61R.61G, 61B, and the color filter substrate which were set by the reflective display are used as mentioned above, the color display only by the reflected light is possible. For this reason, it is possible to switch off a back light and to use it only by reflective display on the outdoors of the usual indoor lighting or daytime. Moreover, by turning on a back light if needed, even when lighting is dark, visibility can be secured.
[0551] In the liquid crystal display concerning the gestalt of this operation, while having not always turned on the back light and being able to reduce power consumption like the conventional transparency mold liquid crystal display, a washout cannot be started by the reflective display 9, and the transparency display using a back light can be performed if needed.
[0552] As mentioned above, it was shown that the active-matrix liquid crystal display of the high resolution which realizes the liquid crystal display method shown in the gestalt 1 of said operation and the gestalt 2 of operation is realizable with the above-mentioned examples 14-17 according to the gestalt of this operation.
[0553] In addition, although the liquid crystal display with which liquid crystal thickness differs by the reflective display 9 and the transparency display 10 was produced by the organic compound insulator 25 (equivalent to an insulator layer 11) to the active-matrix substrate (TFT component substrate) in the above-mentioned examples 14-17, it cannot be overemphasized that the same effectiveness is expectable with the liquid crystal display principle by the other invention in this application.
[0554] [Gestalt 10 of operation] The gestalt of this operation explains below modification of the

brightness of the back light used for the liquid crystal display concerning this invention.
[0555] There are mainly three kinds of purposes which change the brightness of a back light. The 1st purpose is reservation of visibility. As shown in the gestalt 8 of said operation, people's consciousness lightness is prescribed by adaptation luminance and the brightness of the screen. Therefore, as shown in the gestalt 8 of said operation, it is desirable [it is effective to change the brightness of a back light according to the consciousness lightness of people's eyes according to adaptation luminance, and], in order to realize the display of good visibility to change the brightness of the screen by controlling the brightness of a back light according to adaptation luminance so that consciousness lightness may be set to 10 or more brils and less than 30 brils. That is, the above-mentioned back light serves as the screen brightness modification means. Thereby, the visibility in the situation which the transparency display has mainly contributed to the display is improvable. Here, since the value of the consciousness lightness specified in the gestalt 8 of said operation assumes the brightness of the screen proportional to the adaptation luminance to which people have adapted themselves, it can obtain a good display in general by changing the brightness of a back light according to the above-mentioned consciousness lightness.
[0556] The 2nd purpose is reduction of power consumption. There is a case even if it turns on a back light and puts out the light, so that it may not have big effect on visibility. For example, a liquid crystal display is a transflective type liquid crystal display, and the illuminance of the illumination light which illuminates this liquid crystal display from a perimeter is fully high, and it is the case where the brightness of the screen is mainly maintained by the reflective display. In such a case, it is desirable not to influence the brightness of the screen and to switch off a back light even if, for reduction of power consumption in such a case, even if the brightness in a transparency display is high.
[0557] When the color display is performed only to either among the reflective display and the transparency display, the 3rd purpose is completing intentionally a busy condition to which a color display and monochrome display are changed by lighting of a back light, and is giving two or more functions to one liquid crystal display.
[0558] For example, since it becomes possible to take the resolution of a reflective display higher than the transparency display which displays one monochrome unit by two or more pixels using a color filter when do not arrange a color filter to a reflective display, but monochrome display is performed, a color filter is arranged only to a transparency display and color display is performed, a reflective display carries out monochrome display of high resolution, and although it is not high, it is possible [display / transparency / resolution] in a color display. Moreover, a color filter is able to be used only in a reflective display conversely. In this case, it becomes possible to give the function of an application which is different with one liquid crystal display. Therefore, it is possible to change the contents of a display greatly according to the lighting condition by changing a color display and monochrome display by lighting of a back light, or changing the luminescent color.
[0559] As mentioned above, the brightness of a back light is controllable by the suitable signal each time according to the purpose of use or an operating condition. When making it change according to the adaptation luminance which mentioned the brightness of a back light above, the brightness of the above-mentioned back light can be controlled according to visual environment, such as an illuminance of the lighting which carries out incidence to the screen for the purpose of improvement in visibility, and a class of display of a liquid crystal display.
[0560] It is desirable to control the lighting condition of a back light of turning on a back light weakly in order to switch off a back light, and to avoid dazzle when an illuminance is low when an illuminance is high when controlling the brightness of the above-mentioned back light by the illuminance, and turning on a back light strongly when an illuminance is the middle.
[0561] In this case, if the signal from the various external devices connected to the liquid crystal cell or the liquid crystal display, timer control, etc. perform existence of lighting of a back light, and control of brightness according to a user's condition etc., unnecessary power consumption is reducible.
[0562] Furthermore, reduction of the power consumption of the whole device and offer of the good

display to a user can be reconciled by the thing made only for a fixed period to turn on a back light when a user adds a certain actuation to the device equipped with the above-mentioned liquid crystal display on the occasion of control of the brightness of a back light. In addition, the brightness of a back light may be controlled by other various signals in addition to the illuminance of the lighting which carries out incidence to the screen as described above.
[0563] Moreover, it is very effective, when controlling the liquid-crystal orientation in the existence, brightness or a reflective display, and the transparency display of lighting of a back light by the signal which the user inputted into the touch panel (press coordinate detection blocking force means) arranged in piles to the screen of a liquid crystal cell or attaining the purpose which also mentioned above making it the signal which demands a certain cautions from other users interlocked with, and controlling the brightness of a back light. Thus, the liquid crystal display in which coexistence with visibility and a low power is possible can be obtained by controlling the brightness of the screen from the liquid crystal cell outside.
[0564] [Gestalt 11 of operation] The gestalt of this operation explains the concrete configuration of the liquid crystal display concerning this invention at the time of using a touch panel (press coordinate detection blocking force means) as an information input means in the pocket device which are the main fields of the invention of the liquid crystal display of this invention. In addition, the same number is given to the component which has the function as the gestalten 1-10 of said operation of explanation same for convenience, and the explanation is omitted.
[0565] With the gestalt of this operation, the transflective type liquid crystal display of input unit one apparatus was produced for the touch panel in piles to the liquid crystal display of the example 17 in the gestalt 9 of said operation. The configuration of the liquid crystal display of input unit one apparatus concerning the gestalt of this operation is shown in drawing 32. In addition, since it is the same as that of the example 17 in the gestalt 9 of said operation, and the example 5 of the gestalt 2 of said operation, the configuration of the fundamental configuration of those other than touch panel 71 in the liquid crystal display concerning the gestalt of this operation, i.e., a liquid crystal cell, and a back light 13 is omitted here.
[0566] The above-mentioned touch panel 71 is equipped with the movable substrate 73 with which the transparent electrode layer 72 was formed, and the support substrate 75 with which the transparent electrode layer 74 was formed. With the spacer which is not illustrated so that not each transparent electrode layers may contact in an energization condition, these movable substrates 73 and the support substrate 75 have a predetermined gap, and opposite arrangement is carried out while the transparent electrode layer 72 and the transparent electrode layer 74 counter mutually. Thereby, although the transparent electrode layer 72 prepared in the above-mentioned movable substrate 73 and the transparent electrode layer 74 prepared in the above-mentioned support substrate 75 do not contact mutually in a normal state, it contacts mutually in the directed part by directing the above-mentioned movable substrate 73 with a finger or a pen (press). For this reason, the above-mentioned touch panel 71 functions as an input unit by detecting the contact location (coordinate location) of the above-mentioned transparent electrode layer 72 and the transparent electrode layer 74 by the thrust applied to the movable substrate 73.
[0567] The above-mentioned touch panel 71 is sticking the phase contrast compensating plate 16 and a polarizing plate 14 on the above-mentioned movable substrate 73, and is arranged in one with the above-mentioned phase contrast compensating plate 16 and the polarizing plate 14 between the phase contrast compensating plate 16 and the substrate 4 of a liquid crystal cell. In the gestalt of this operation, in order to acquire the effectiveness of the polarizing plate in said example 17 with the polarizing plate 14 on which it was stuck on the touch panel 71, the movable substrate 73 and the support substrate 75 which constitute the above-mentioned touch panel 71 are produced with the ingredient without a birefringence.
[0568] Moreover, with the gestalt of this operation, the thrust of touch panel 71 HE considered as the

configuration which does not get across to a liquid crystal cell, without using a thrust buffer member by preparing a gap between the support substrate 75 of a touch panel 71, and the substrate 4 of a liquid crystal cell, and keeping this gap constant in order to give the thrust transfer prevention effectiveness to this liquid crystal display between a touch panel 71 and the substrate 4 of a liquid crystal cell for the above-mentioned liquid crystal display.
[0569] Thus, as for the liquid crystal display of constituted above-mentioned input-device one apparatus, it is possible by changing the brightness of a back light 13 with the signal of a touch panel 71 to switch off a back light 13, when the user is not observing the display, and to make a back light 13 turn on with the input of the information on a touch panel 71. Therefore, according to the gestalt of this operation, the liquid crystal display which was compatible in a good display and reduction of power consumption was realizable. Moreover, since according to the gestalt of this operation absorption by the polarizing plate 14 can also absorb the unnecessary reflected light by the touch panel 71 and can reduce this unnecessary reflected light by arranging in the order which mentioned above the above-mentioned polarizing plate 14, the touch panel 71, and the liquid crystal cell, visibility can be improved.
[0570]
[Effect of the Invention] The substrate of a pair with which, as for the liquid crystal display of invention according to claim 1, the orientation means was given to the front face which counters as mentioned above, It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrates of this pair. It is arbitrary and the orientation device for making coincidence take at least two kinds of different orientation conditions is provided to a different field used for the display in the above-mentioned liquid crystal layer. And a reflective means is allotted to at least one field among the fields which show a different orientation condition in the above-mentioned liquid crystal layer, and the field which shows a different orientation condition is the configuration of being used for the reflective display which performs a reflective display, and the transparency display which performs a transparency display, the account of a top.
[0571] According to the above-mentioned configuration, by having the orientation condition that liquid crystal orientation differs in coincidence, in using coloring matter, such as dichroism coloring matter, for a display and using the amount of absorption of light (absorption coefficient), and an optical anisotropy, it becomes possible to change the magnitude of the amount of modulations of each optical physical quantity called phase contrast for every field where liquid crystal orientation differs. For this reason, according to the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity according to the orientation condition of a liquid crystal layer can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned configuration, the effectiveness that it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered is done so.
[0572] The liquid crystal display of invention according to claim 2 is the configuration that the above-mentioned orientation device is the contents rewriting means of a display which rewrites the contents of a display in connection with the passage of time, as mentioned above.
[0573] The effectiveness that the liquid crystal display of the claim 1 above-mentioned publication can be obtained is done so, without according to the above-mentioned configuration, the same means' being able to realize the contents rewriting means of a display, and the above-mentioned orientation device, and adding a new configuration.
[0574] The liquid crystal display concerning invention according to claim 3 As mentioned above, it is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrate of a pair with which the orientation means was given to the front face which counters, and the substrate of this pair. While each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid

crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display A reflective means is allotted to a reflective display at least, and the liquid crystal thickness of the above-mentioned reflective display is a configuration smaller than a transparency display.

[0575] According to the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned configuration, the effectiveness that it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered is done so.

[0576] The liquid crystal display concerning invention according to claim 4 is the configuration that the orientation means is given so that at least two kinds of different directions of orientation may be given to the field on the contact surface which contacts the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of the above-mentioned pair as mentioned above in the orientation of the liquid crystal layer interface which touches it.

[0577] According to the above-mentioned configuration, in the field to which the above-mentioned liquid crystal layer is the arbitration for using for the display in this liquid crystal layer, and differ at the time of electrical-potential-difference impression, at least two kinds of different orientation conditions are shown in coincidence, and the effectiveness that a reflective display and a transparency display can be performed in the field in which the orientation conditions in the above-mentioned liquid crystal layer differ is done so. Moreover, by changing the elevation angle over the substrate of liquid crystal orientation, and its azimuth according to the above-mentioned configuration, both the orientation of the liquid crystal which determines an optical property, and the orientation change at the time of impressing an electrical potential difference can be changed, and the effectiveness of becoming possible to perform the display which was suitable for each display by the reflective display and the transparency display is collectively done so.

[0578] The liquid crystal display of invention according to claim 5 is the configuration that the percentages that the area of the reflective display to the area of the sum total of the above-mentioned reflective display and a transparency display occupies are 30% or more and 90% or less, as mentioned above.

[0579] In the ratio of a reflective display and a transparency display, the optimal ratio for carrying out a good display exists by the displays for which it asks, such as whether although a good display is realizable by both the reflective display and the transparency display with the means which was mentioned above according to this invention, color display is performed or monochrome display is performed, it displays by indicating it a subject by reflective, or to display by indicating it a subject by transparency. According to the above-mentioned configuration, when performing color display by both the above-mentioned reflective display and the transparency display, the effectiveness that a good display can be performed by both the above-mentioned reflective display and the transparency display is done so.

[0580] The liquid crystal display of invention according to claim 6 is the configuration that a reflective display serves as clear display as mentioned above at coincidence when the above-mentioned transparency display is clear display, and a reflective display becomes coincidence with a dark display when the above-mentioned transparency display is a dark display.

[0581] According to this invention, the liquid crystal display of invention of the claim 6 above-mentioned publication is having the configuration of above-mentioned claims 1 or 3, when the above-mentioned transparency display is clear display, a reflective display considers as clear display at coincidence, and when the above-mentioned transparency display is a dark display, it can be considered as a dark display by the reflective display at coincidence. Especially, according to this invention, if it remains as it is, even

if it is the case where the contents of a display are reversed by the reflective display and the transparency display, said contents rewriting means of a display can be used for said orientation device, and a display can be easily arranged by controlling rewriting of the contents of a display by the reflective display and the transparency display according to an individual, for example. Therefore, according to the above-mentioned configuration, the effectiveness that good visibility is securable is done so.

[0582] The liquid crystal display of invention according to claim 7 is the configuration that the above-mentioned liquid crystal layer consists of a liquid crystal constituent which comes to mix in liquid crystal the coloring matter which has dichroism as mentioned above.

[0583] According to the above-mentioned configuration, the effectiveness that the amount of absorption of light can be rationalized is done so by the reflective display and the transparency display.

[0584] The liquid crystal display of invention according to claim 8 is the configuration that the polarizing plate is arranged among the substrates of the above-mentioned pair at the non-contact side side with the liquid crystal layer in one [at least] substrate, as mentioned above.

[0585] According to the above-mentioned configuration, by the reflective display and the transparency display, a birefringence can be rationalized and the effectiveness that a good display can be performed is done so.

[0586] The liquid crystal display of invention according to claim 9 is equipped with an electrical-potential-difference impression means to impress an electrical potential difference to the above-mentioned liquid crystal layer, as mentioned above. This electrical-potential-difference impression means The phase contrast of the display light on the reflective means of the reflective display at the time of electrical-potential-difference impression It is the configuration of impressing an electrical potential difference so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of clear display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of clear display and a dark display.

[0587] Moreover, the liquid crystal display of invention according to claim 10 is a configuration in which the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of the above-mentioned pair on the twist square of 60 degrees or more and 100 degrees or less as mentioned above. Thus, with constituting, change of the polarization near the rotatory polarization according to a twist of the orientation of liquid crystal can be used for a display in the liquid crystal layer of a transparency display, and change of the rotatory polarization and the polarization by control of a retardation can be used for a display in a reflective display.

[0588] The liquid crystal display of invention according to claim 11 is a configuration in which the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of the above-mentioned pair on the twist square of 0 times or more and 40 degrees or less as mentioned above. Thus, with constituting, both change of a retardation can be used for a display also in the liquid crystal layer of a reflective display also in the liquid crystal layer of a transparency display.

[0589] According to the configuration of above-mentioned claims 9-11, the variation of phase contrast which was respectively suitable for the reflective display or the transparency display can be obtained by the reflective display and the transparency display, and the effectiveness that the change of the display with clear display and a dark display is attained is done so.

[0590] As mentioned above, the above-mentioned liquid crystal display component is at least one side among the above-mentioned reflective display and a transparency display, and the liquid crystal display of invention according to claim 12 is a configuration which displays by changing the orientation condition of a liquid crystal layer by rotating a liquid crystal molecule in parallel to a substrate.

[0591] It is the configuration equipped with an electrical-potential-difference impression means by which the above-mentioned liquid crystal display component produces an electrical-potential-difference impression means by which the above-mentioned liquid crystal display component makes the above-

mentioned liquid crystal layer produce [liquid crystal·display / of invention according to claim 13] electric field in the field inboard of a substrate, in the above-mentioned liquid crystal layer as mentioned above, and makes the field inboard of a substrate produce electric field, among the above-mentioned reflective display and the transparency display corresponding to either.

[0592] Sufficient display is possible even if orientation change of liquid crystal is only modification of bearing in a field parallel to a substrate in this invention. And in this invention, the effectiveness that the lowness of the efficiency for light utilization of an in plane switching method is conquerable is done so by using positively for a display the insufficiency of the liquid crystal orientation leading to the low light transmittance which is the technical problem of the conventional in plane switching method as a reflective display.

[0593] The liquid crystal display of invention according to claim 14 is the configuration that one [at least] substrate equips the field at least corresponding to one side with the orientation film which has a perpendicular stacking tendency among the above-mentioned reflective display in the contact surface with the above-mentioned liquid crystal layer, and the transparency display, among the substrates of the above-mentioned pair as mentioned above.

[0594] In this invention, although the orientation of a liquid crystal layer may be parallel orientation that to a display used as mentioned above, it may be perpendicular orientation as for which liquid crystal is carrying out orientation perpendicularly to the substrate. [than before] [more] Thus, the above-mentioned substrate is equipped with the orientation film which has a perpendicular stacking tendency, and when liquid crystal orientation is the perpendicular orientation as for which liquid crystal is carrying out orientation perpendicularly to the substrate, the contrast ratio of a display does so the effectiveness that there is an advantage which becomes good.

[0595] It is the configuration of being formed so that it may become thicker than the field corresponding to a transparency display in the direction of the field corresponding to [equip the field corresponding to / liquid crystal display / of invention according to claim 15 / as mentioned above / among the above-mentioned reflective display and transparency displays / at least / a reflective display in one / among the substrates of the above-mentioned pair / at least / substrate with an insulator layer, and / insulator layer / this] the above-mentioned reflective display in the thickness.

[0596] According to the above-mentioned configuration, the field used for the display in a liquid crystal layer does so the effectiveness that the liquid crystal display (namely, liquid crystal display with which liquid crystal thickness differs by a reflective display and the transparency display) which has at least two kinds of different liquid crystal thickness can be obtained easily.

[0597] The liquid crystal display of invention according to claim 16 can be set to one substrate among the substrates of the above-mentioned pair as mentioned above. To the field corresponding to a transparency display, among the fields which constitute the viewing area of each pixel To a part of field [at least] corresponding to a reflective display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area It is the configuration that the color filter arranged on the field corresponding to the transparency display in the above-mentioned substrate and the color filter which has the same lightness are arranged.

[0598] When performing color display, if the color filter of a transparency display is used for a reflective display as it is, lightness runs short, but while according to the above-mentioned configuration lightness is compensated and color display becomes possible also not only to a transparency display but to a reflective display, a reflection factor required for a reflective display can be secured, it is indicated a subject by transparency, and the effectiveness that the transflective type liquid crystal display in which color display is possible can be offered is done so.

[0599] The liquid crystal display of invention according to claim 17 can be set to one substrate among the substrates of the above-mentioned pair as mentioned above. To the field corresponding to a transparency display, among the fields which constitute the viewing area of each pixel To a part of field [at least] corresponding to a reflective display among the fields which the color filter which has

transparency color is arranged, and constitute the above-mentioned viewing area It is the configuration that the color filter which has transparency color with lightness higher than the color filter arranged on the field corresponding to the transparency display in the above-mentioned substrate is arranged.
[0600] When performing color display, while according to the above-mentioned configuration lightness is compensated and color display becomes possible also not only to a transparency display but to a reflective display, a reflection factor required for a reflective display can be secured, it is indicated a subject by transparency, and the effectiveness that the transflective type liquid crystal display in which color display is possible can be offered is done so. In this case, in a reflective display, display light passes a color filter twice. For this reason, by arranging the color filter which has transparency color with lightness higher than the color filter arranged on the field corresponding to a reflective display to the field corresponding to the transparency display in the above-mentioned substrate, lightness can be raised more and better color display can be performed.
[0601] The liquid crystal display of invention according to claim 18 is the configuration that the area of the field which the color filter which has transparency color is arranged, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned color filter is set as the field corresponding to a transparency display at least as mentioned above among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned pair.
[0602] According to the above-mentioned configuration, the rate which the pixel of each color contributes to lightness can be changed with the luminous transmittance of each color, consequently the effectiveness that a good display is realizable is done so.
[0603] The liquid crystal display of invention according to claim 19 is the configuration that the color filter which has transparency color to the field corresponding to a reflective display at least as mentioned above among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned pair is arranged.
[0604] When performing the display which indicates it a subject by reflective according to the above-mentioned configuration, the liquid crystal display which is excellent in visibility and can perform high resolution color display can be offered. In this case, the permeability of light rises especially at a reflective display by performing monochrome display, without performing color display and using a color filter in a transparency display. For this reason, in such a case, it is possible to set up a transparency display still smaller, the area of a reflective display can be more greatly secured to it, and the effectiveness that a better display can usually be obtained in the reflective display at the time of use is done so to it.
[0605] The liquid crystal display of invention according to claim 20 is the configuration that the area of the field which does not perform the color display of a transparency display is set up as mentioned above according to the luminous transmittance of the transparency color of the above-mentioned color filter.
[0606] Since the contribution to the lightness from monochrome display of the transparency display in each pixel can be set up proper in consideration of luminous transmittance when performing the display which indicates it a subject by reflective according to the above-mentioned configuration, the effectiveness that a better display can be obtained is done so.
[0607] The liquid crystal display of invention according to claim 21 can be set to one substrate among the substrates of the above-mentioned pair as mentioned above. To the field corresponding to a reflective display, among the fields which constitute the viewing area of each pixel To a part of field [at least] corresponding to a transparency display among the fields which the color filter which has transparency color is arranged, and constitute the above-mentioned viewing area It is the configuration that the color filter arranged on the field corresponding to the reflective display in the above-mentioned substrate and the color filter with which saturation has the transparency color more than an EQC are arranged.

[0608] According to the above-mentioned configuration, the effectiveness that good color display can be performed by both the reflective display and the transparency display and that the transflective type liquid crystal display which indicates it a subject by reflective can be offered is done so.
[0609] The liquid crystal display of invention according to claim 22 is equipped with the lighting system which carries out incidence of the light to the above-mentioned liquid crystal display component from the tooth back of this liquid crystal display component as mentioned above, and is the configuration that this lighting system serves as a screen brightness modification means to change the brightness of the screen.
[0610] According to the above-mentioned configuration, the effectiveness that coexistence with a low power and visibility can be aimed at by changing the brightness of the screen with a lighting system is done so.
[0611] The liquid crystal display of invention according to claim 23 is the configuration that the above-mentioned lighting system changes the brightness of the screen according to adaptation luminance so that consciousness lightness may be set to 10 or more brils and less than 30 brils, as mentioned above.
[0612] While according to the above-mentioned configuration being able to improve the visibility in the situation which the transparency display has mainly contributed to the display and being able to realize good visibility, the effectiveness that low-power-ization can be attained is done so.
[0613] The liquid crystal display of invention according to claim 24 is the configuration of providing a press coordinate detection blocking force means to detect the coordinate location pressed as mentioned above when it was arranged in piles and pressed by the screen.
[0614] According to the above-mentioned configuration, in the transflective type above liquid crystal displays, use of the press coordinate detection blocking force means mentioned above as compared with the reflective mold liquid crystal display using the so-called front light does so easily the effectiveness that the small liquid crystal display of the power consumption of good input unit one apparatus can be offered.
[0615] The liquid crystal display of invention according to claim 25 is arranged in piles as mentioned above at the screen, a press coordinate detection blocking force means to detect the coordinate location pressed by being pressed is provided, and the above-mentioned lighting system is the configuration of the output signal of the above-mentioned press coordinate detection blocking force means being interlocked with, and changing the brightness of the screen.
[0616] Since it is detected easily according to the above-mentioned configuration that the observer is using the display with the signal of the above-mentioned press coordinate detection blocking force means, if the brightness of the lighting system which influences the power consumption of a liquid crystal display according to this signal is changed and the brightness of the screen is changed, the effectiveness that it is compatible in reduction of power consumption and good visibility will be done so.
[0617] The liquid crystal display of invention according to claim 26 is arranged in piles as mentioned above at the screen, a press coordinate detection blocking force means detect the coordinate location pressed by being pressed is provided, and the above-mentioned orientation device is the configuration of the output signal of the above-mentioned press coordinate detection blocking force means being interlocked with, and changing the orientation condition of the liquid-crystal layer at least in one side among the above-mentioned reflective display and a transparency display.
[0618] Since it is detected easily according to the above-mentioned configuration that the observer is using the display with the signal of the above-mentioned press coordinate detection blocking force means, if liquid crystal orientation is changed according to this signal, the effectiveness that it is compatible in reduction of power consumption and good visibility will be done so.
[0619] The liquid crystal display of invention according to claim 27 is the configuration that provide the press coordinate detection blocking force means and polarizing plate which detect the coordinate location pressed as mentioned above when it was arranged in piles and pressed by the screen, and the above-mentioned polarizing plate, the press coordinate detection blocking force means, and the liquid

crystal display component are arranged at this order.

[0620] While doing so the effectiveness have a polarizing plate and a press coordinate detection blocking force means, and use a birefringence for a display and that the small liquid crystal display of the power consumption of input unit one apparatus can be offered according to the above-mentioned configuration, absorption by the polarizing plate also absorbs the unnecessary reflected light by the press coordinate detection blocking force means, and does so collectively the effectiveness of realizing good visibility.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the important section sectional view of the liquid crystal display concerning the gestalt 1 of operation of this invention.

[Drawing 2] It is the display property Fig. of a liquid crystal display given in an example 1.

[Drawing 3] It is the display property Fig. of a liquid crystal display given in the example 2 of a comparison, and the example 3 of a comparison.

[Drawing 4] It is the important section sectional view of the liquid crystal display concerning the gestalt 2 of operation of this invention.

[Drawing 5] It is drawing explaining the definition of a rubbing crossed axes angle.

[Drawing 6] It is the display property Fig. of a liquid crystal display given in an example 2.

[Drawing 7] It is the display property Fig. of a liquid crystal display given in an example 3.

[Drawing 8] It is the display property Fig. of a liquid crystal display given in an example 4.

[Drawing 9] It is the display property Fig. of a liquid crystal display given in an example 5.

[Drawing 10] It is the display property Fig. of a liquid crystal display given in an example 6.

[Drawing 11] It is the display property Fig. of a liquid crystal display given in an example 7.

[Drawing 12] It is the display property Fig. of a liquid crystal display given in the example 3 of a comparison.

[Drawing 13] It is the display property Fig. of a liquid crystal display given in an example 8.

[Drawing 14] It is the display property Fig. of a liquid crystal display given in the example 4 of a comparison.

[Drawing 15] It is the display property Fig. of a liquid crystal display given in the example 5 of a comparison.

[Drawing 16] It is the display property Fig. of a liquid crystal display given in an example 9.

[Drawing 17] It is orientation processing process drawing of the substrate used for the liquid crystal display concerning the gestalt 4 of operation of this invention.

[Drawing 18] (a) – (e) is the cross section showing roughly orientation down stream processing shown in drawing 17 .

[Drawing 19] It is the display property Fig. of a liquid crystal display given in an example 10.
[Drawing 20] It is the display property Fig. of a liquid crystal display given in an example 11.
[Drawing 21] (a) is an important section sectional view at the time of no electrical-potential-difference impressing the liquid crystal display concerning an example 12, and (b) is an important section sectional view at the time of electrical-potential-difference impression of the liquid crystal display shown in (a).
[Drawing 22] It is the display property Fig. of a liquid crystal display given in an example 12.
[Drawing 23] (a) is the important section top view of the TFT component substrate for realizing the liquid crystal display of a transparency subject transflective type concerning the gestalt 7 of operation of this invention, (b) is drawing showing the drive electrode of the reflective display in the TFT component substrate shown in (a), and (c) is drawing showing the transparence pixel electrode in the TFT component substrate shown in (a).
[Drawing 24] It is the A-A' line view sectional view of the TFT component substrate shown in drawing 23 (a).
[Drawing 25] It is the B-B' line view sectional view of the TFT component substrate shown in drawing 23 (a).
[Drawing 26] (a) is the sectional view of a color-filter [that an above-mentioned color-filter substrate is the important section top view of the liquid crystal display of an above-mentioned / that fracture shows / transparency subject transflective type a part, and (b) shows the physical relationship of a color filter / forming in the color-filter substrate of the liquid crystal display of a transparency / starting the gestalt 7 of the operation of this invention / subject transflective type /, and opening for the transparency display of a drive / forming in the reflective display in a TFT / showing in drawing 23 (a) / component substrate / electrode to (a)] substrate.
[Drawing 27] It is the C-C' line view sectional view of the important section of the liquid crystal display shown in drawing 26 (a).
[Drawing 28] It is the important section top view of the TFT component substrate for realizing the liquid crystal display of a reflective subject transflective type concerning the gestalt 7 of operation of this invention.
[Drawing 29] (a) is the sectional view of a color-filter [that an above-mentioned color-filter substrate is the important section top view of the liquid crystal display of an above-mentioned / that fracture shows / reflective subject transflective type a part, and (b) shows the physical relationship of a color filter / forming in the color-filter substrate of the liquid crystal display of a reflective / starting the gestalt 7 of the operation of this invention / subject transflective type /, and opening for the transparency display of a drive / forming in the reflective display in a TFT / showing in drawing 28 / component substrate / electrode to (a)] substrate.
[Drawing 30] It is a value diagram that the relation between the adaptation luminance which gives the consciousness lightness of equivalence, and sample brightness is shown etc.
[Drawing 31] It is the property Fig. showing the relation of the illuminance and consciousness lightness in the transflective type liquid crystal display concerning the gestalt 8 of operation of this invention.
[Drawing 32] It is the important section sectional view showing the outline configuration of the liquid crystal display of input unit one apparatus concerning the gestalt 11 of operation of this invention.
[Description of Notations]
1 Liquid Crystal Layer
1a Liquid crystal molecule
2 Orientation Film (Orientation Device)
3 Orientation Film (Orientation Device)
4 Substrate
5 Substrate
6 Electrode (the Contents Rewriting Means of Display, Electrical-Potential-Difference Impression Means, Orientation Device)

7 Electrode (the Contents Rewriting Means of Display, Electrical-Potential-Difference Impression Means, Orientation Device)
8 Reflective Film (Reflective Means)
9 Reflective Display
10 Transparency Display
11 Insulator Layer (Orientation Device)
12 Dichroism Coloring Matter (Orientation Device)
13 Back Light (Lighting System, Screen Brightness Modification Means)
14 Polarizing Plate
15 Polarizing Plate
16 Phase Contrast Compensating Plate
17 Phase Contrast Compensating Plate
18 Pixel Electrode (the Contents Rewriting Means of Display, Electrical-Potential-Difference Impression Means)
19 Drive Electrode (the Contents Rewriting Means of Display, Electrical-Potential-Difference Impression Means)
19a Opening for a transparency display
20 Transparence Pixel Electrode (the Contents Rewriting Means of Display, Electrical-Potential-Difference Impression Means)
21 TFT Component
22 Drain Terminal
23 Wiring
24 Wiring
25 Organic Compound Insulator
26 Auxiliary Part by Volume
27 Auxiliary Capacity Line
28 Source Terminal
29 Substrate
40 Electrode Substrate
41 Substrate
42 Orientation Film (Orientation Device)
42a Orientation processing field
42b Orientation processing field
52 Glass Substrate
53 Kushigata Electrode (the Contents Rewriting Means of Display, Electrical-Potential-Difference Impression Means, Orientation Device)
54 Substrate
61R Color filter
61G Color filter
61B Color filter
62 Glass Substrate
71 Touch Panel (Press Coordinate Detection Blocking Force Means)
72 Transparent Electrode Layer
73 Movable Substrate
74 Transparent Electrode Layer
75 Support Substrate
100 Liquid Crystal Cell (Liquid Crystal Display Component)
101 Electrode Substrate
102 Electrode Substrate

200 Liquid Crystal Cell (Liquid Crystal Display Component)
201 Electrode Substrate
202 Electrode Substrate
501 Smoothing Layer
502 Counterelectrode (the Contents Rewriting Means of Display, Electrical-Potential-Difference Impression Means)

[Translation done.]

CORRECTION OR AMENDMENT

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[Proposed Amendment]
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[Title of the Invention] Liquid crystal display

[Claim(s)]

[Claim 1] It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrate of a couple with which the orientation means was given to the front face which counters, and the substrate of this couple,

It has a reflective display and a transparency display,

The liquid crystal thickness of the above-mentioned reflective display is a liquid crystal display characterized by being thinner than the liquid crystal thickness of a transparency display.

[Claim 2] The liquid crystal display according to claim 1 characterized by giving the above-mentioned orientation means so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of a up Norikazu pair in the orientation of the liquid crystal layer interface which touches it.

[Claim 3] The liquid crystal display according to claim 1 or 2 characterized by for a reflective display serving as clear display simultaneously when the above-mentioned transparency display is clear display, and a reflective display serving as a dark display simultaneous when the above-mentioned transparency display is a dark display.

[Claim 4] A liquid crystal display given in any 1 term of claims 1-3 characterized by the above-mentioned liquid crystal layer consisting of a liquid crystal constituent which comes to mix in liquid crystal the coloring matter which has dichroism.

[Claim 5] A liquid crystal display given in any 1 term of claims 1-4 characterized by arranging the polarizing plate among the substrates of a up Norikazu pair at the non-contact side side with the liquid crystal layer in one [at least] substrate.

[Claim 6] It has an electrical-potential-difference impression means to impress an electrical potential difference to the above-mentioned liquid crystal layer. This electrical-potential-difference impression means The phase contrast of the display light on the reflective means of the reflective display at the time of electrical-potential-difference impression The liquid crystal display according to claim 5 characterized by impressing an electrical potential difference so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of clear display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of clear display and a dark display.

[Claim 7] The liquid crystal display according to claim 5 or 6 with which the above-mentioned liquid crystal layer is characterized by carrying out twist orientation on the twist square of 60 degrees or more and 100 degrees or less between the substrates of a up Norikazu pair.

[Claim 8] The liquid crystal display according to claim 5 or 6 with which the above-mentioned liquid crystal layer is characterized by carrying out twist orientation on the twist square of 0 times or more and 40 degrees or less between the substrates of a up Norikazu pair.

[Claim 9] The above-mentioned liquid crystal display component is a liquid crystal display given in claims 1-3 which are at least one side among the above-mentioned reflective display and a transparency display, and are characterized by displaying by changing the orientation condition of a liquid crystal layer by making parallel rotate a liquid crystal molecule to a substrate, and any 1 term of 5 or 6.

[Claim 10] The above-mentioned liquid crystal display component is a liquid crystal display according to claim 9 characterized by equipping the above-mentioned liquid crystal layer with an electrical-potential-difference impression means to make the field inboard of a substrate produce electric field, among the above-mentioned reflective display and a transparency display corresponding to either.

[Claim 11] It is a liquid crystal display given in claims 1-6 characterized by one [at least] substrate equipping the field at least corresponding to one side with the orientation film which has a vertical stacking tendency among the above-mentioned reflective display in the contact surface with the above-mentioned liquid crystal layer, and a transparency display among the substrates of a up Norikazu pair, and any 1 term of 9 or 10.

[Claim 12] It is a liquid crystal display given in any 1 term of claims 1-11 to which one [at least] substrate equips the field corresponding to a reflective display with an insulator layer at least among the above-mentioned reflective display and a transparency display among the substrates of a up Norikazu pair, and it is characterized by forming this insulator layer so that the direction of the field corresponding to the above-mentioned reflective display in the thickness may become thicker than the field corresponding to a transparency display.
[Claim 13] The above-mentioned insulator layer is a liquid crystal display according to claim 12 with which it is prepared in the substrate by the side of the screen among the substrates of a up Norikazu pair, and the substrate by the side of the screen matched for the above-mentioned reflective display with the above-mentioned insulator layer is characterized by allotting the reflective means on the substrate of an opposite hand on both sides of a liquid crystal layer.
[Claim 14] The above-mentioned insulator layer is a liquid crystal display according to claim 12 characterized by forming a reflective means to have concavo-convex structure and to have concavo-convex structure on this insulator layer.
[Claim 15] To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the light filter which has transparency color is arranged, and constitute the above-mentioned viewing area A liquid crystal display given in any 1 term of claims 1-12 characterized by arranging the light filter arranged on the field corresponding to the transparency display in the above-mentioned substrate, and the light filter which has the same lightness.
[Claim 16] To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the light filter which has transparency color is arranged, and constitute the above-mentioned viewing area A liquid crystal display given in any 1 term of claims 1-12 characterized by arranging the light filter which has transparency color with lightness higher than the light filter arranged on the field corresponding to the transparency display in the above-mentioned substrate.
[Claim 17] A liquid crystal display given in claims 1-12 characterized by to set at least the area of the field which the light filter which has transparency color is arranged, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned light filter as the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair, and 15 or 16 any 1 terms.
[Claim 18] A liquid crystal display given in any 1 term of claims 1-12 characterized by arranging the light filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair.
[Claim 19] The liquid crystal display according to claim 18 characterized by setting up the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of the transparency color of the above-mentioned light filter.
[Claim 20] To the field corresponding to a reflective display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a transparency display among the fields which the light filter which has transparency color is arranged, and constitute the above-mentioned viewing area A liquid crystal display given in any 1 term of claims 1-12 characterized by arranging the light filter arranged on the field corresponding to the reflective display in the above-mentioned substrate, and the light filter with which saturation has the transparency color more than an EQC.
[Claim 21] A liquid crystal display given in claims 1-12 to which it has the lighting system which carries

out incidence of the light to the above-mentioned liquid crystal display component from the tooth back of this liquid crystal display component, and this lighting system is characterized by serving as a screen brightness modification means to change the brightness of the screen, and any 1 term of 15-20.
[Claim 22] The above-mentioned lighting system is a liquid crystal display according to claim 21 characterized by changing the brightness of the screen according to adaptation luminance so that perception lightness may be set to 10 or more brils and less than 30 brils.
[Claim 23] A liquid crystal display given in claims 1-12 characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by the screen, and any 1 term of 15-22.
[Claim 24] It is the liquid crystal display according to claim 21 or 22 characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by the screen, interlocking with [output signal / of the above-mentioned press coordinate detection blocking force means] the above-mentioned lighting system, and changing the brightness of the screen.
[Claim 25] A liquid crystal display given in claims 1-12 characterized by providing the press coordinate detection blocking force means and polarizing plate which detect the coordinate location pressed when it was arranged in piles and pressed by the screen, and arranging the above-mentioned polarizing plate, the press coordinate detection blocking force means, and the liquid crystal display component at this order, and any 1 term of 15-24.
[Claim 26] The screen side in the liquid crystal display concerned is equipped with a polarizing plate at least among a polarizing plate and a phase contrast compensating plate,
the above-mentioned polarizing plate, a phase-contrast compensating plate, and a liquid-crystal layer change the polarization condition of the incident light made into the linearly polarized light with the above-mentioned polarizing plate with a phase-contrast compensating plate if needed, and change it in the liquid-crystal layer of the above-mentioned reflective display further -- the polarization condition on the reflective means of the above-mentioned reflective display at the time of a dark display -- right and left -- the liquid crystal display according to claim 1 characterized by to consider as the circular polarization of light which may be the surroundings of which.
[Claim 27] The liquid crystal display according to claim 1 characterized by having equipped the outside of one substrate with the phase contrast compensating plate of one sheet among the substrates of a up Norikazu pair, and equipping the outside of the substrate of another side with the phase contrast compensating plate of two sheets.
[Claim 28] The liquid crystal display according to claim 1 characterized by arranging the phase contrast compensating plate and the polarizing plate on the outside of the substrate of a up Norikazu pair.
[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display used especially in more detail in the intense environment of change of the liquid crystal display with which the outdoors and indoor are used, an automobile, the aircraft, a marine vessel, etc. of a lighting environment about the liquid crystal display used for information machines and equipment, such as a word processor and a notebook sized personal computer, various visual equipments and a game device, the pocket mold VCR, a digital camera, etc.
[0002]
[Description of the Prior Art] Conventionally, the cathode-ray tube (CRT;Cathode Ray Tube), an electroluminescence (EL;ElectroLuminescence) component, a plasma display panel (PDP;Plasma DisplayPanel), etc. are electrically put in practical use as a spontaneous light type display which can rewrite the content of a display.
[0003] However, in order for a spontaneous light type display to make the display light itself emit light and to use it for a display, it has the trouble that power consumption is large. Furthermore, since the

luminescence side of a spontaneous light type display is the screen which has a high reflection factor in itself, when a spontaneous light type display is used, compared with luminescence brightness, the so-called washout phenomenon in which it becomes impossible to observe display light is not avoided in the situation; for example, the direct sunlight lower etc., that an ambient light is strong of an operating environment etc.

[0004] On the other hand, the liquid crystal display is given to practical use as a color display which displays an alphabetic character and an image by adjusting the amount of transmitted lights of the light from the specific light source, without the display light itself emitting light. This liquid crystal display (LCD;Liquid Crystal Display) can be divided roughly into a transparency mold liquid crystal display and a reflective mold liquid crystal display.

[0005] Among those, what is used current, especially widely as a color liquid crystal display is a transparency mold liquid crystal display using the light source called the so-called background lighting (back light) to a background, i.e., the tooth back of a liquid crystal cell. Although it had advantages, such as a thin shape and a light weight, and the application is expanded in various fields, it is one of these, this transparency mold liquid crystal display consumes a lot of power in order to make background lighting (back light) emit light, and although there is little power used for the permeability modulation of liquid crystal, it requires comparatively big power.

[0006] However, in such a transparency mold liquid crystal display (namely, transparency mold color liquid crystal display), the washout phenomenon looked at by said spontaneous light type display is reduced. This is because the reflection factor of the screen of the light filter layer by which the object for facilities is carried out to the transparency mold color liquid crystal display is reduced by the low reflection factor-ized technique of the light filter layer using a black matrix etc.

[0007] However, even if it is the case where a transparency mold color liquid crystal display is used, an ambient light is dramatically strong, and when display light is weak, observation of display light becomes difficult relatively. For this reason, that such a trouble should be solved, if the background illumination light is reinforced further, the problem of consuming more power will be invited.

[0008] Since a reflective mold liquid crystal display displays to the above luminescence mold displays or a transparency mold liquid crystal display using an ambient light, the display light proportional to the amount of ambient lights can be obtained. For this reason, a reflective mold liquid crystal display has the theoretic advantage of not causing the above-mentioned washout phenomenon, and can observe a display on the contrary more vividly in a very bright location where direct sunlight hits. furthermore, since a reflective mold liquid crystal display does not need background lighting (back light) in the display, it can reduce the power for making background lighting (back light) emit light -- etc. -- it has the advantage. For this reason, especially the reflective mold liquid crystal display fits the activity on the outdoors, such as a Personal Digital Assistant device, and a digital camera, a pocket video camera.

[0009] However, in the reflective mold liquid crystal display of these former, in order to use an ambient light for a display, the degree for which display brightness depends on a circumference environment is dramatically high, and has the trouble that the content of a display cannot be checked, under the weak environment of an ambient light. When the light filter used in order to realize a color display (color display) especially is used, in order that a light filter may absorb light, a display becomes dark further. Therefore, in such a case, the above-mentioned problem becomes much more remarkable.

[0010] Then, the lighting system called a front light is developed as supplemental lighting so that a reflective mold liquid crystal display can be used also under the weak environment of an ambient light. The reflecting plate is installed in the tooth back of a liquid crystal layer, and background lighting (back light) like a transparency mold liquid crystal display cannot be used for a reflective mold liquid crystal display. For this reason, the lighting system (front light) used for a reflective mold liquid crystal display illuminates a reflective mold liquid crystal display from a front, i.e., the screen, side.

[0011] It considers as the liquid crystal display with which the perimeter illumination light, on the other hand, enables the activity under a weak environment taking advantage of the advantage of a reflective

mold liquid crystal display, a part of incident light is penetrated, and the liquid crystal display using the so-called semi-permeable reflective film made to reflect the remaining incident light is put in practical use. Thus, generally the liquid crystal display using both the transmitted light and the reflected light is called the transflective LCD.

[0012] For example, the transflective LCD which performs a lightness modulation to JP,59-218483,A (it corresponds to a Japanese-Patent-Application-No. No. 92885 [58 to] official report) using TN (Twisted Nematic) method and the liquid crystal display method which modulates transmitted light reinforcement, such as a STN (super twisted nematic) method, is indicated. Moreover, the transflective LCD with which the reflective film arranged by approaching a liquid crystal layer has semi-permeable is indicated by JP,7-318929,A. Furthermore, the transparency mold liquid crystal display using the in plane switching method as a technique of realizing a large angle of visibility is indicated by JP,6-160878,A.

[0013]

[Problem(s) to be Solved by the Invention] However, a transflective LCD given in JP,59-218483,A is a trouble (1) since the semi-permeable reflective film is arranged on the rear face of a liquid crystal cell, in view of the observer side, as shown below. And (2) It has.

[0014] That is, it is (1) first. Difficulty is followed on setting out of the lightness which influences the conspicuousness of a display. That is, to set up the lightness of a transflective LCD according to the lightness in the case of performing a reflective display, it is necessary to set up this lightness highly in preparation for an activity on conditions which run short of ambient lights. However, if the permeability of the polarizing plate used in TN method in order to make lightness high is set up highly, in a transparency display, the contrast ratios which ** and are defined by the lightness of a dark display of the lightness of clear display will run short, and visibility will be worsened. Although it is desirable to set up this lightness so that a contrast ratio may be raised on the other hand when setting up the above-mentioned lightness according to the lightness in the case of performing a transparency display, in a reflective display, lightness runs short in this case, and visibility is worsened.

[0015] Moreover, (2) In a reflective display, in order to reflect the light which passes the liquid crystal layer pinched by the substrate by the reflective film in which it was prepared at the rear face of a liquid crystal cell and to observe a display, the parallax (double image) in a reflective display will be seen, lowering of resolution will be caused, and a high resolution display will be difficult.

[0016] Moreover, since the reflective film itself has semi-permeable, the transflective LCD given in said JP,7-318929,A has the trouble that the optical design suitable for a reflective display and a transparency display is impossible.

[0017] Furthermore, although the in plane switching method currently indicated in said JP,6-160878,A is used for the transparency mold liquid crystal display, the liquid crystal orientation on the Kushigata electrode does not contribute to a display. When this electrode wiring is many, since this is produced with a metal without translucency, it is because liquid crystal orientation change is inadequate for a transparency display.

[0018] Then, the invention-in-this-application person etc. tried to apply the means of displaying used for the reflective mold liquid crystal display which can control parallax to a transflective LCD that these technical problems should be solved. Specifically, it is (a). GH (guest host) method and (b) which arranged the liquid crystal constituent which mixed in the liquid crystal layer the coloring matter (dichroism coloring matter) which has dichroism It examined wholeheartedly using two methods of the reflective mold liquid crystal display method (it is hereafter written as an one-sheet polarizing plate method) using one polarizing plate for a transflective display.

[0019] In addition, the above (a) And (b) In order to arrange on the occasion of examination of utilization of means of displaying which does not produce parallax as shown in two methods so that the reflective film may be ****(ed) in a liquid crystal layer, and to enable it to also use the transmitted light for a display in addition to the reflected light, a part for transparency opening was prepared in the reflective film.

[0020] Consequently, the trouble of further the following became clear. First, (a) By GH method, if the concentration of the dichroism coloring matter mixed in a liquid crystal constituent is adjusted so that it may be suitable for a reflective display, in a transparency display, although lightness is high, it runs short of contrast ratios, and cannot obtain a good display. On the other hand, if the concentration of the above-mentioned dichroism coloring matter mixed in a liquid crystal constituent is adjusted so that it may be suitable for a transparency display, although a good contrast ratio is obtained, by the reflective display, lightness cannot fall and a good reflective display cannot be obtained at a transparency display.
[0021] Moreover, (b) A polarizing plate etc. is further added to the tooth back of whether when using an one-sheet polarizing plate method for a transflective display, setting out of the electrical potential difference impressed to the liquid crystal orientation and liquid crystal thickness which determine an optical property, or the liquid crystal which drives them is set up according to a reflective display, and the screen, a transparency display is performed (two-sheet polarizing plate method), and two kinds of whether to set up to compensate for this transparency display can be considered.
[0022] First, the display in the transparency display at the time of setting liquid crystal thickness as the thickness suitable for a reflective display is explained. Outside the electric field of the liquid crystal layer at the time of setting up the liquid crystal layer suitable for a reflective display etc., the amount of change of the polarization condition accompanying the orientation change by the field is extent from which it goes and comes back to a liquid crystal layer, and sufficient contrast ratio is obtained, when the front, i.e., the light which carried out incidence through the liquid crystal layer from the screen side, carries out outgoing radiation to a screen side through a liquid crystal layer again. However, in this setting out, the transparency display of the variation of the polarization condition of the light which passed the liquid crystal layer is inadequate. For this reason, even if it installs the polarizing plate used only for a transparency display in the tooth back of a liquid crystal cell in addition to the polarizing plate installed in the observer, i.e., the screen, side of the liquid crystal cell used for a reflective display, in view of an observer side, display sufficient in a transparency display is not obtained. That is, when the orientation conditions of a liquid crystal layer are set as the orientation conditions (liquid crystal thickness, liquid crystal orientation, etc.) of a liquid crystal layer of having been suitable for the reflective display, even if lightness runs short or a transparency display is enough as lightness, the permeability of a dark display does not fall and sufficient contrast ratio for a display is not obtained.
[0023] If it furthermore explains to a detail, when performing a reflective display, the orientation condition of the liquid crystal in the above-mentioned liquid crystal layer is controlled by the electrical potential difference impressed to the above-mentioned liquid crystal layer so that the phase contrast of quarter-wave length is given in general to the light which passes a liquid crystal layer only at once. If only the electrical-potential-difference modulation which gives the phase modulation of quarter-wave length to the light which passes a liquid crystal layer is performed using the liquid crystal layer set up that such phase contrast should be given to the light which passes a liquid crystal layer and a transparency display is performed When fully reducing permeability in case a transparency display is a dark display, when a transparency display is clear display, the light of the reinforcement of abbreviation one half is absorbed with the polarizing plate by the side of the outgoing radiation of light, and sufficient clear display is not obtained. Moreover, since lightness in case a transparency display is clear display is increased, if optical elements, such as a polarizing plate and a phase contrast compensating plate, are arranged, lightness in case a transparency display is a dark display will turn into lightness of the abbreviation 1/2 of the lightness at the time of clear display, and the contrast ratio of a display will serve as imperfection.
[0024] Next, the display in the reflective display at the time of setting the orientation conditions of a liquid crystal layer as the conditions suitable for a transparency display is explained. When performing a reflective display in the liquid crystal layer suitable for a transparency display, the polarization condition of the light which passes a liquid crystal layer only at once needs to control liquid crystal orientation by the electrical-potential-difference modulation to become irregular between two polarization conditions

which intersect perpendicularly mostly. Here, two polarization conditions which intersect perpendicularly may be the two linearly polarized lights which have the plane of vibration which intersects perpendicularly, and you may be the circular polarization of light on either side, and major-axis bearing may intersect perpendicularly by two elliptically polarized light of the still more nearly same ovality, and the hand of cut of a photoelectrical community may be reversed. In order to realize the modulation of the polarization condition between the combination of these two polarization conditions that intersect perpendicularly, it is necessary to carry out an electrical-potential-difference modulation so that 1/2 wave of phase contrast may be given to the transmitted light in a liquid crystal layer. Thus, in any case, when the polarization condition of light becomes irregular between two polarization conditions which intersect perpendicularly, an operation of a polarizing plate and an operation of the phase contrast compensating plate used if needed can realize sufficient lightness and a sufficient contrast ratio in a transparency display.

[0025] When the above-mentioned liquid crystal layer is set up that such control should be realized, however, in a transparency display While changing from clear display to a dark display only at once, it sets to a reflective display. When the orientation change means of liquid crystal is the same, the display of the same light and darkness cannot be realized -- fluctuation of a reflection factor becomes a dark display from clear display, and becomes clear display further -- (for example, when the thickness of a liquid crystal layer is the same and also drives initial orientation on the same and still more nearly same electrical potential difference). In addition, the above (a) - (b) The technical problem produced in a case is the same as that of said JP,7-318929,A also in the transflective LCD of a publication.

[0026] Moreover, since itself has the reflexibility over light, the press sensing input device (touch panel) used for a liquid crystal display in piles has the trouble of being easy to worsen visibility, and the inclination is remarkable in especially a reflective mold liquid crystal display.

[0027] Moreover, the front light unit with which an ambient light improves the visibility of the reflective mold liquid crystal display in a dark environment is the light pipe structure of a plane [many], and since the content of a display is observed over this light pipe, while saying that visibility tends to get worse, it has ****.

[0028] This invention is made in view of the above-mentioned trouble, and the object is excellent in visibility, and a high resolution display is possible, and it is in offering the liquid crystal display which can use both the reflected light and the transmitted light for a display. Moreover, the further object of this invention is excellent in visibility, and high resolution color display is possible for it, and it is to offer the liquid crystal display which can use both the reflected light and the transmitted light for a display.

[0029]

[Means for Solving the Problem] It is the liquid crystal display equipped with the liquid crystal display component which has the liquid-crystal layer pinched between the substrate of a couple with which the orientation means (for example, orientation film) was given to the front face which counters in order that the liquid crystal display according to claim 1 concerning this invention might solve the above-mentioned technical problem, and the substrate of this couple, and it has a reflective display and a transparency display and the liquid-crystal thickness of the above-mentioned reflective display is characterized by to be thinner than the liquid-crystal thickness of a transparency display.

[0030] When extent of the amount of modulations of each optical physical quantity, such as the amount of absorption of light and phase contrast by the optical anisotropy, is independently changed by the reflective display and the transparency display, Even when the direction of orientation of the liquid crystal by impression of an electrical potential difference is almost the same in the whole field for using for the display of a liquid crystal layer, in the field in which the liquid crystal thickness of a liquid crystal layer differs, it has substantially the same operation as the case where the direction of orientation of a liquid crystal layer is changed in this field. Coloring matter, such as dichroism coloring matter, is used especially, in the polarizing plate method using GH method using the absorption of light, a birefringence, or a rotatory-polarization phenomenon, each of each phenomena of the absorption of light produced in a

liquid crystal layer and a birefringence is phenomena accompanying propagation of light, and each phenomenon has relevance between the propagation distance of the light in a liquid crystal layer, and extent of those phenomena. Furthermore, display light passes a liquid crystal layer twice by round trip in a reflective display, in order to pass a liquid crystal layer only at once in a transparency display, when liquid crystal orientation is almost the same and liquid crystal thickness is similarly set up by the reflective display and the transparency display, sufficient lightness or a sufficient contrast ratio are not obtained and said technical problem is not solved.
[0031] However, according to the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. In addition, in the above-mentioned liquid crystal display, the reflective means (for example, the reflective film and a reflector) is allotted to the reflective display at least. According to the above-mentioned configuration, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired even when an ambient light is strong. For this reason, according to the above-mentioned configuration, it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0032] The liquid crystal display according to claim 2 concerning this invention In order to solve the above-mentioned technical problem, it sets to a liquid crystal display according to claim 1. It is characterized by giving the orientation means so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of a up Norikazu pair in the orientation of the liquid crystal layer interface which touches it.
[0033] Thus, as a means for having the orientation condition that liquid crystal orientation differs simultaneously, it is given to the interface on the substrate which touches for example, the above-mentioned liquid crystal layer in addition to the content rewriting means of a display, for example, and the orientation film by which orientation processing was carried out so that at least two kinds of different directions of orientation might be given to the orientation of the liquid crystal layer interface which touches it can be used. By thus, the thing performed for the orientation means so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in the above-mentioned substrate front face in the orientation of the liquid crystal layer interface which touches it In the field to which the above-mentioned liquid crystal layer is the arbitration for using for the display in this liquid crystal layer, and differ at the time of electrical-potential-difference impression, at least two kinds of different orientation conditions can be shown simultaneously, and a reflective display and a transparency display can be performed in the field in which the orientation conditions in the above-mentioned liquid crystal layer differ.
[0034] In this case, both the orientation of the liquid crystal which determines an optical property, and the orientation change at the time of impressing an electrical potential difference can be changed by changing the elevation angle over the substrate of liquid crystal orientation, and its azimuth, and it becomes possible to perform the display which was suitable for each display by the reflective display and the transparency display.
[0035] Moreover, it is desirable for the content of a display not to be reversed by the reflective display from a viewpoint and transparency display of visibility. It is for the contrast ratio of a display with the reinforcement of an ambient light being large, and changing this, if a lighting environment changes or the content of a display is reversed by the reflective display and the transparency display in a situation with difficult prediction of change of a lighting environment, and fluctuation of such a contrast ratio serves as the same phenomenon as a washout, and causes large aggravation of visibility from the point of visibility.

[0036] Then, it is dramatically important that a reflective display displays clear display simultaneously when a transparency display is clear display, and a reflective display displays a dark display simultaneously when a transparency display is a dark display, when securing visibility.
[0037] For this reason, the liquid crystal display according to claim 3 concerning this invention is characterized by for a reflective display serving as clear display simultaneously, when the above-mentioned transparency display is clear display, and a reflective display serving as a dark display simultaneous, when the above-mentioned transparency display is a dark display in the liquid crystal display according to claim 1 or 2, in order to solve the above-mentioned technical problem.
[0038] Moreover, in order that the liquid crystal display according to claim 4 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display given in any 1 term of claims 1-3, the above-mentioned liquid crystal layer is characterized by consisting of a liquid crystal constituent which comes to mix the coloring matter which has dichroism at liquid crystal.
[0039] According to the above-mentioned configuration, when the above-mentioned liquid crystal layer consists of a liquid crystal constituent which comes to mix in liquid crystal the coloring matter which has dichroism, the amount of absorption of light can be rationalized by the reflective display and the transparency display.
[0040] Moreover, it is also effective to use the method which uses a birefringence and a rotatory-polarization phenomenon for a display by both the reflective display and the transparency display, using a polarizing plate as means of displaying for performing a good display.
[0041] For this reason, the liquid crystal display according to claim 5 concerning this invention is characterized by arranging the polarizing plate among the substrates of a up Norikazu pair at the non-contact side side with the liquid crystal layer in one [at least] substrate in the liquid crystal display given in any 1 term of claims 1-4, in order to solve the above-mentioned technical problem.
[0042] According to the above-mentioned configuration, by the reflective display and the transparency display, a birefringence can be rationalized and a good display can be performed. In order to use a polarizing plate method for a reflective display and to secure sufficient display in a transparency display with the liquid crystal display of the claim 1 above-mentioned publication at this time, it is required not only for a screen side but the incidence side of the light of a transparency display to have a polarizing plate.
[0043] Moreover, in a reflective display, as for the variation of the phase contrast of the light from which the orientation change by the electrical potential difference of a liquid crystal layer is also hung down in the liquid crystal display of the claim 5 above-mentioned publication, it is desirable to set up so that it may be suitable for the light which goes and comes back to a liquid crystal layer, and to set up so that it may be suitable for the light which penetrates a liquid crystal layer in a transparency display, when changing a display.
[0044] For this reason, the liquid crystal display according to claim 6 concerning this invention In order to solve the above-mentioned technical problem, in a liquid crystal display according to claim 5, it has an electrical-potential-difference impression means (for example, electrode) to impress an electrical potential difference to the above-mentioned liquid crystal layer. This electrical-potential-difference impression means The phase contrast of the display light on the reflective means of the reflective display at the time of electrical-potential-difference impression It is characterized by impressing an electrical potential difference so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of clear display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of clear display and a dark display.
[0045] In this case, as are shown in claim 7, and the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of a up Norikazu pair on the twist square of 60 degrees or more and 100 degrees or less or it is shown in claim 8, as for the liquid crystal orientation in the above-mentioned liquid crystal layer, specifically, it is desirable that the above-mentioned liquid crystal layer is

carrying out twist orientation between the substrates of a up Norikazu pair on the twist square of 0 times or more and 40 degrees or less.

[0046] The above-mentioned liquid-crystal layer can use change of the polarization near the rotatory polarization according to a twist of the orientation of liquid crystal for a display in the liquid-crystal layer of a transparency display with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 60 degrees or more and 100 degrees or less, and it can use change of the polarization by control with the rotatory polarization and a retardation for a display in a reflective display between the substrates of a up Norikazu pair.

[0047] Moreover, the above-mentioned liquid crystal layer can use both change of a retardation for a display also in the liquid crystal layer of a reflective display also in the liquid crystal layer of a transparency display between the substrates of a up Norikazu pair with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 0 times or more and 40 degrees or less.

[0048] Moreover, in a liquid crystal display given in above-mentioned claims 1-3 and any 1 term of 5 or 6, even if orientation change of liquid crystal is only modification of bearing in a field parallel to a substrate, sufficient display is possible for it.

[0049] Namely, the liquid crystal display according to claim 9 concerning this invention In a liquid crystal display given in claim claims 1-3 and any 1 term of 5 or 6 in order to solve the above-mentioned technical problem the above-mentioned liquid crystal display component It is characterized by displaying by changing the orientation condition of a liquid crystal layer among the above-mentioned reflective display and the transparency display by making parallel rotate a liquid crystal molecule to a substrate at least by one side.

[0050] Furthermore, in this invention, the lowness of the efficiency for light utilization of an in plane switching method is conquerable by using positively for a display the insufficiency of the liquid crystal orientation leading to the low light transmittance which is the technical problem of the conventional in plane switching method as a reflective display.

[0051] That is, in order that the liquid crystal display according to claim 10 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display according to claim 9, the above-mentioned liquid crystal display component is characterized by equipping the above-mentioned liquid crystal layer with an electrical-potential-difference impression means to produce electric field in the field inboard of a substrate, among the above-mentioned reflective display and a transparency display corresponding to either.

[0052] Moreover, although the orientation of a liquid crystal layer may be parallel orientation that to a display used, it may be vertical orientation as for which liquid crystal is carrying out orientation vertically to the substrate. [than before] [more]

[0053] The liquid crystal display according to claim 11 concerning this invention In a liquid crystal display given in claims 1-6 and any 1 term of 9 or 10 in order to solve the above-mentioned technical problem one [at least] substrate among the substrates of a up Norikazu pair It is characterized by equipping the field at least corresponding to one side with the orientation film which has a vertical stacking tendency among the above-mentioned reflective display in the contact surface with the above-mentioned liquid crystal layer, and a transparency display.

[0054] Thus, the above-mentioned substrate is equipped with the orientation film which has a vertical stacking tendency, and there is an advantage to which the contrast ratio of a display becomes good in being the vertical orientation as for which liquid crystal is carrying out orientation vertically to the substrate, and moreover, when performing a good display to above-mentioned claims 1-6, and 9 or 10 in the liquid crystal display of a publication, it acts effectively.

[0055] Moreover, the liquid crystal display according to claim 12 concerning this invention In a liquid crystal display given in any 1 term of claims 1-11 in order to solve the above-mentioned technical problem One [at least] substrate equips the field corresponding to a reflective display with an insulator

layer at least among the above-mentioned reflective display and a transparency display among the substrates of a up Norikazu pair. This insulator layer The thickness is characterized by being formed so that the direction of the field corresponding to the above-mentioned reflective display may become thicker than the field corresponding to a transparency display.
[0056] That is, the above-mentioned liquid crystal display has an insulator layer on one [which pinches a liquid crystal layer / at least] almost smooth substrate, this insulator layer is a field corresponding to a transparency display, it is formed so that thickness may become thin rather than the field corresponding to a reflective display, or the insulating layer is formed only in the field corresponding to a reflective display, and the insulator layer is not formed in the field corresponding to a transparency display.
[0057] According to the above-mentioned configuration, the field used for the display in a liquid crystal layer can obtain easily the liquid crystal display (namely, liquid crystal display with which liquid crystal thickness differs by the reflective display and the transparency display) which has at least two kinds of different liquid crystal thickness.
[0058] Moreover, the above-mentioned insulator layer can be impressed to a liquid crystal layer without loss of the electrical potential difference which drives a liquid crystal layer by forming the electrode for a display in the field where it not only acts as an adjustment means of liquid crystal thickness, but the above-mentioned insulator layer touches a liquid crystal layer in a reflective display.
[0059] In this case, the film which has light reflex nature as a reflective means in the substrate by the side of the screen and the substrate by which opposite arrangement was carried out is formed. It is effective that the film which has this light reflex nature has concavo-convex structure as a mirror plane nature prevention means of the reflective display which does not spoil resolution, without spoiling the display engine performance of a transparency display. The above-mentioned insulator layer can form easily the film which has the above-mentioned light reflex nature which has concavo-convex structure by having the membranous concavo-convex structure of having the above-mentioned light reflex nature, and the same concavo-convex structure.
[0060] in addition, the substrate with which the configuration for changing liquid crystal thickness by the reflective display and the transparency display is pinching liquid crystal -- at least -- either -- even having -- what is necessary is just to be Therefore, the screen side may be matched with the above-mentioned insulator layer on both sides of the liquid crystal layer on the substrate by the side of [instead of / on the substrate of an opposite hand] the screen. However, even if it is such a case, a reflective means is formed on the substrate of an opposite hand on both sides of a liquid crystal layer with a screen side.
[0061] That is, in the liquid crystal display according to claim 12, the above-mentioned insulator layer is prepared in the substrate by the side of the screen among the substrates of a up Norikazu pair, and the liquid crystal display according to claim 13 concerning this invention is characterized by allotting the reflective means on the substrate of an opposite hand on both sides of a liquid crystal layer at the above-mentioned reflective display with the substrate by the side of the screen to which the above-mentioned insulator layer was allotted, in order to solve the above-mentioned technical problem.
[0062] Moreover, in order that the liquid crystal display according to claim 14 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display according to claim 12, it is characterized by forming a reflective means for the above-mentioned insulator layer to have concavo-convex structure, and to have concavo-convex structure on this insulator layer.
[0063] Moreover, when performing color display using the liquid crystal display of this invention, the design of not only a liquid crystal layer but a light filter layer important for coloring is important. According to examination of invention-in-this-application persons, there are two kinds of main activity gestalten of a transflective type liquid crystal display.
[0064] By one usually mainly using a transparency display in an activity, and using a reflective display additionally Prevent the washout under the very strong lighting environment of an ambient light, and it

compares with a luminescence mold display or the liquid crystal display of only a transparency display. It is the activity gestalt which secures the large versatility of an usable lighting environment and which indicates it a subject by transparency. Another usually, in an activity, under the weak environment of lighting taking advantage of the property of reflective display that there is little power consumption By turning on and using the lighting system called the so-called back light, it is the activity gestalt which secures the large versatility of an usable environment like a previous activity gestalt and which indicates it a subject by reflective.
[0065] In a previous activity gestalt (activity gestalt which indicates it a subject by transparency), among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair, at least, it excels in visibility by arranging the light filter which has transparency color to the field corresponding to a transparency display, and high resolution color display is possible and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0066] And especially the thing for which the light filter which has transparency color is arranged on a transparency display at least, and the light filter which arranges the light filter which has the same lightness as the light filter arranged on the transparency display in a part of reflective display [at least], not using a light filter on a reflective display, or has the high transparency color of lightness rather than it is arranged on each pixel when performing color display in this way is effective.
[0067] If the light filter of a transparency display is used for a reflective display as it is, when it will be because lightness runs short and a reflective display will also perform color display, this By arranging the light filter which establishes the field which does not use a light filter in a reflective display, or has the high transparency color of lightness rather than a transparency display in a reflective display It is because lightness is suppliable, color display becomes possible and a reflection factor required for a reflective display can be secured also to a reflective display.
[0068] And in a reflective display, if it takes into consideration that display light passes a light filter twice, it is desirable to arrange the light filter which has the high transparency color of lightness rather than a transparency display on a reflective display.
[0069] Moreover, in the activity gestalt which indicates it a subject by transparency, when considering as the configuration which has the field which does not prepare a light filter in a reflective display, a display voltage signal required for a transparency display is the signal for which it was suitable to the color display, and a display voltage signal required for a reflective display is the signal it was suitable to monochrome display in the example which is not used at all in a light filter to a reflective display. Therefore, although the rate which the pixel of each color contributes to lightness when considering as the configuration which does not prepare a light filter in a reflective display is proportional to the luminous transmittance of each color in a transparency display, since it becomes equal, when considering as the configuration which does not prepare a light filter in a reflective display, with a reflective display, it is desirable [it is each color and] in changing the area of the field which does not perform in the color display of a reflective display according to the luminous transmittance of each color of the light filter used for a transparency display.
[0070] Namely, the liquid crystal display according to claim 15 concerning this invention In a liquid crystal display given in any 1 term of claims 1-12 in order to solve the above-mentioned technical problem To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the light filter which has transparency color is arranged, and constitute the above-mentioned viewing area It is characterized by arranging the light filter arranged on the field corresponding to the transparency display in the above-mentioned substrate, and the light filter which has the same lightness.
[0071] Moreover, the liquid crystal display according to claim 16 concerning this invention In a liquid crystal display given in any 1 term of claims 1-12 in order to solve the above-mentioned technical

problem To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the light filter which has transparency color is arranged, and constitute the above-mentioned viewing area It is characterized by arranging the light filter which has transparency color with lightness higher than the light filter arranged on the field corresponding to the transparency display in the above-mentioned substrate.

[0072] Furthermore, the liquid crystal display according to claim 17 concerning this invention In a liquid crystal display given in claims 1-12 and 15 or 16 any 1 terms in order to solve the above-mentioned technical problem The inside of the field which constitutes the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair, It is characterized by setting at least the area of the field which the light filter which has transparency color is arranged, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned light filter as the field corresponding to a transparency display.

[0073] Moreover, it sets in the second activity gestalt (activity gestalt which indicates it a subject by reflective). By arranging the light filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair It excels in visibility, and high resolution color display is possible, and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.

[0074] And especially the thing for which the light filter which arranges at least the light filter which has transparency color on a reflective display, and performs a color display to each pixel, has the same saturation as the light filter arranged on the reflective display at a part of transparency display [at least] in a transparency display, not using a light filter, or has the high transparency color of saturation rather than it is arranged when performing color display in this way is effective.

[0075] In the activity gestalt which indicates it a subject by reflective, in a transparency display, when monochrome display is performed not using a light filter, since the permeability of light rises, it is possible to set up a transparency display still smaller. Thereby, the area of a reflective display can be secured more greatly and a better display can usually be obtained in the reflective display at the time of an activity.

[0076] Moreover, in the activity gestalt which indicates it a subject by reflective, the contribution to the lightness of monochrome display of the transparency display in each pixel can be set up proper in consideration of luminous transmittance by changing the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of each color of the light filter used for a reflective display.

[0077] That is, the liquid crystal display according to claim 18 concerning this invention is characterized by arranging the light filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair in the liquid crystal display given in any 1 term of claims 1-12, in order to solve the above-mentioned technical problem.

[0078] Moreover, the liquid crystal display according to claim 19 concerning this invention is characterized by setting up the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of the transparency color of the above-mentioned light filter in the liquid crystal display according to claim 18, in order to solve the above-mentioned technical problem.

[0079] Furthermore, the liquid crystal display according to claim 20 concerning this invention In a liquid crystal display given in any 1 term of claims 1-12 in order to solve the above-mentioned technical problem To the field corresponding to a reflective display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a transparency display among the fields which the light filter which has

transparency color is arranged, and constitute the above-mentioned viewing area It is characterized by arranging the light filter arranged on the field corresponding to the reflective display in the above-mentioned substrate, and the light filter with which saturation has the transparency color more than an EQC.

[0080] Moreover, since the above-mentioned liquid crystal display concerning this invention is equipped with the reflective display as mentioned above, it doubles and has the description of the low power in the conventional reflective mold liquid crystal display. However, continuing maintaining this at a burning condition causes buildup of power consumption using the big illumination light of power consumption.

[0081] Then, in order that the liquid crystal display according to claim 21 concerning this invention may solve the above-mentioned technical problem, it has the lighting system which carries out incidence of the light to claims 1-12 and any 1 term of 15-20 from the tooth back of this liquid crystal display component in the liquid crystal display of a publication at the above-mentioned liquid crystal display component, and is characterized by this lighting system serving as a screen brightness modification means to change the brightness of the screen.

[0082] According to the above-mentioned configuration, coexistence with a low power and visibility can be aimed at by changing the brightness of the screen with a lighting system.

[0083] Furthermore, in order that the liquid crystal display according to claim 22 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display according to claim 21, the above-mentioned lighting system is characterized by changing the brightness of the screen according to adaptation luminance, so that perception lightness may be set to 10 or more brils and less than 30 brils.

[0084] The above-mentioned perception lightness is prescribed by adaptation luminance and the brightness of the screen. At this time, it is dramatically desirable to change the brightness of the screen so that the above-mentioned perception lightness may be acquired by changing the reinforcement of burning, putting out lights, or lighting according to the adaptation luminance from which the above-mentioned lighting system changes with the content of a display of a liquid crystal display and the visual environment of lighting etc., when aiming at coexistence with a low power and visibility. When the above-mentioned lighting system is especially controlled by press coordinate detection blocking force means, such as a touch panel, etc. from the liquid crystal display component outside, the above-mentioned effectiveness will become much more remarkable.

[0085] Moreover, low-power-ization can be attained, while according to the above-mentioned configuration being able to improve the visibility in the situation which the transparency display has mainly contributed to the display and being able to realize good visibility.

[0086] Moreover, in the transflective type liquid crystal display concerning this invention, as compared with the reflective mold liquid crystal display using the so-called front light, the activity of press coordinate detection blocking force means, such as a touch panel, is easy, and there is a big advantage at this point. Therefore, it is effective to realize the display good at a transflective type using such a press coordinate detection blocking force means because of the small liquid crystal display of the power consumption of good input unit one apparatus.

[0087] That is, the liquid crystal display according to claim 23 concerning this invention is characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by claims 1-12 and any 1 term of 15-22 in the liquid crystal display of a publication at the screen, in order to solve the above-mentioned technical problem.

[0088] Furthermore, since it is compatible in the cutback of power consumption, and good visibility, it is effective to change the brightness of the lighting system which influences the power consumption of a liquid crystal display according to this signal, and to change the brightness of the screen, since it is easily detected that the observer is using the display with the signal of this press coordinate detection blocking force means when such a press coordinate detection blocking force means is used, or to change liquid-crystal orientation.

[0089] Then, the liquid crystal display according to claim 24 concerning this invention In order to solve the above-mentioned technical problem, it sets to a liquid crystal display according to claim 21 or 22. It is characterized by providing a press coordinate detection blocking force means to detect the coordinate location pressed when it was arranged in piles and pressed by the screen, interlocking with [output signal / of the above-mentioned press coordinate detection blocking force means] the above-mentioned lighting system, and changing the brightness of the screen.
[0090] Moreover, when the above-mentioned liquid crystal display concerning this invention is equipped with both the above-mentioned press coordinate detection blocking force means and a polarizing plate, the above-mentioned press coordinate detection blocking force means and a polarizing plate are arranged in order of a polarizing plate, a press coordinate detection blocking force means, and a liquid crystal display component.
[0091] Namely, the liquid crystal display according to claim 25 concerning this invention In a liquid crystal display given in claims 1-12 and any 1 term of 15-24 in order to solve the above-mentioned technical problem The press coordinate detection blocking force means and polarizing plate which detect the coordinate location pressed when it was arranged in piles and pressed by the screen are provided, and it is characterized by arranging the above-mentioned polarizing plate, the press coordinate detection blocking force means, and the liquid crystal display component at this order.
[0092] By arranging the above-mentioned polarizing plate, a press coordinate detection blocking force means, and a liquid crystal display component in this way, absorption by the polarizing plate can also absorb the unnecessary reflected light by the press coordinate detection blocking force means, and can reduce this unnecessary reflected light. Therefore, according to the above-mentioned configuration, the visibility of the liquid crystal display concerning this invention can be improved.
[0093] Moreover, the liquid crystal display according to claim 26 concerning this invention In order to solve the above-mentioned technical problem, it sets to a liquid crystal display according to claim 1. The screen side in the liquid crystal display concerned is equipped with a polarizing plate at least among a polarizing plate and a phase contrast compensating plate. The above-mentioned polarizing plate, a phase contrast compensating plate, and a liquid crystal layer The polarization condition of the incident light made into the linearly polarized light with the above-mentioned polarizing plate by making it change with phase contrast compensating plates if needed, and making it change in the liquid crystal layer of the above-mentioned reflective display further the polarization condition on the reflective means of the above-mentioned reflective display at the time of a dark display -- right and left -- it is characterized by considering as the circular polarization of light which may be the surroundings of which.
[0094] According to the above-mentioned configuration, an ideal dark display is realizable by the reflective display.
[0095] Furthermore, the liquid crystal display according to claim 27 concerning this invention is characterized by having equipped the outside of one substrate with the phase contrast compensating plate of one sheet among the substrates of a up Norikazu pair, and equipping the outside of the substrate of another side with the phase contrast compensating plate of two sheets in the liquid crystal display according to claim 1, in order to solve the above-mentioned technical problem.
[0096] A phase contrast compensating plate is used for modification of the dependency of the lightness over prevention of the coloring often seen and the potential difference of an electrode, and a pan for modification of a display angle of visibility etc., when it does not have a phase contrast compensating plate used. When the above-mentioned liquid crystal display is equipped with the phase contrast compensating plate, sufficient lightness and a sufficient contrast ratio can be secured to the light of two or more wavelength of a light region.
[0097] Furthermore, the liquid crystal display according to claim 28 concerning this invention is characterized by arranging the phase contrast compensating plate and the polarizing plate on the outside of the substrate of a up Norikazu pair in the liquid crystal display according to claim 1, in order to solve the above-mentioned technical problem.

[0098] It is also effective to use the method which uses a birefringence and a **** phenomenon for a display by both the reflective display and the transparency display, using a polarizing plate as means of displaying for performing a good display. Therefore, according to the above-mentioned configuration, a birefringence can be rationalized by the reflective display and the transparency display, and a good display can be performed. Moreover, a phase contrast compensating plate is used for modification of the dependency of the lightness over prevention of the coloring often seen and the potential difference of an electrode, and a pan for modification of a display angle of visibility etc., when it does not have a phase contrast compensating plate used. Therefore, sufficient lightness and a sufficient contrast ratio are securable to the light of two or more wavelength of a light region by the above-mentioned liquid crystal display being equipped with a phase contrast compensating plate.
[0099]
[Embodiment of the Invention] The liquid crystal display by this invention is characterized by the ability of the liquid crystal orientation of a reflective display, and the liquid crystal orientation of a transparency display to take the condition of differing at this time of day. Here, liquid crystal orientation shall show not only average orientation bearing of the liquid crystal molecule in a point with a liquid crystal layer but the coordinate dependency of average orientation bearing to the coordinate taken in the direction of a normal of the layer of a layer-like liquid crystal layer. So, this invention classifies and explains greatly the orientation device in which it is used for this approach at the approach list which realizes liquid crystal orientation which is different by the reflective display and the transparency display to three kinds.
[0100] The 1st approach is an approach of changing the liquid crystal orientation of a reflective display, and the liquid crystal orientation of a transparency display, by using the orientation device produced so that conditions with a liquid crystal layer might differ by the transparency display and the reflective display.
[0101] Specifically as the 1st approach of the above, it is (1). The approach and (2) using the orientation device which carries out twist orientation so that it may have the twist angle from which liquid crystal orientation completely differs by the transparency display and the reflective display The approach using the orientation device in which the tilt angle to the substrate of liquid crystal orientation is made to change greatly etc. is mentioned. Moreover, in the 1st approach of the above, it is (3). The approach of arranging a liquid crystal ingredient which is different by the transparency display and the reflective display, (4) How (by the transparency display and the reflective display in this case) to change a transparency display and a reflective display in the class and concentration of the coloring matter mixed in liquid crystal ingredient The liquid crystal display which it is included that the same liquid crystal ingredient may be used etc. and applied to this invention possesses the device made when realizing such an approach as an orientation device of this invention. Moreover, the orientation devices in which it is used for this approach at the approach list of the above 1st are these (1). - (4) An approach may be combined and the orientation device in which it is used for this approach at these approach lists can realize liquid crystal orientation which is different by the reflective display and the transparency display.
[0102] The 2nd approach is an approach (namely, the approach as the content rewriting means of a display that the orientation device in which liquid crystal orientation is changed by the transparency display and the reflective display is the same) of changing liquid crystal orientation by the transparency display and the reflective display with the content rewriting means of a display which rewrites the content of a display in connection with the passage of time. The existing rewriting means of a display can be used as a content rewriting means of a display used when adopting this approach.
[0103] Specifically as the 2nd approach of the above, it is (5). The approach of changing the approach (i.e., the electrical potential difference itself used as a content rewriting means of a display) of rewriting liquid crystal orientation by the transparency display and the reflective display by using an electrode which is different by the transparency display and the reflective display as an orientation device etc. is employable. Moreover, it is (6) as the 2nd approach of the above. Although the electrode is the same,

the approach of changing the electrical potential difference substantially impressed to liquid crystal orientation may be used. Above (6) When adopting an approach, the liquid crystal orientation of a transparency display and the liquid crystal orientation of a reflective display which are driven with a common electrode may be changed by arranging the insulator (for example, insulator layer) of thickness which is different by the reflective display and the transparency display between a liquid crystal layer and the electrode which drives it. Moreover, (7) The approach of changing the direction of electric field by the transparency display and the reflective display may be used. For example, it is arranged at parallel at one side of the substrate which pinches a liquid crystal layer, and when displaying on a liquid crystal layer by the electrode group which gives respectively different potential by changing the direction of liquid crystal orientation within a liquid crystal stratification plane, since liquid crystal orientation differs greatly, the field where these liquid crystal orientation differs may be respectively used for a reflective display and a transparency display inter-electrode and on an electrode. Furthermore, the approach of giving respectively different potential to the liquid crystal layer which carried out orientation vertically to the substrate by the same electrode group may be adopted. When adopting the 2nd approach of the above, an electrode, insulators, or such combination are equivalent to the orientation device of this invention, and the obtained liquid crystal display which was used when realizing the above-mentioned approach has become a thing possessing these orientation devices, for example.

[0104] The 3rd approach is the approach of changing the thickness of the liquid-crystal layer which is the element which determines an optical property although the liquid-crystal orientation itself is not greatly different by the reflective display and the transparency display, and the insulator layer formed in thickness which is different by for example, the reflective display and the transparency display, the substrate which were formed in the thickness or the configuration in which a reflective display differs from a transparency display are used for implementation of this approach as the above-mentioned orientation device.

[0105] When adopting the 3rd approach of the above, the liquid crystal orientation twisted uniformly may be used for liquid crystal orientation like TN method used with the liquid crystal display which uses two polarizing plates. In this case, orientation of the liquid crystal orientation is carried out to parallel to a substrate between the substrates which pinch a liquid crystal layer, and twist orientation of that direction of orientation is carried out, changing a direction in a substrate flat surface according to the distance from one substrate. If this liquid crystal orientation is changed and liquid crystal thickness is used for a reflective display and a transparency display for it, since an optical property changes with liquid crystal thickness, a good display is realizable by both the reflective display and the transparency display.

[0106] Moreover, also in GH method, since there is the same effectiveness as the case where coloring matter concentration is substantially changed by change of liquid crystal thickness, even if the liquid crystal orientation itself is almost the same at a reflective display and a transparency display, it can realize a good display to each of a reflective display and a transparency display.

[0107] As mentioned above, although the orientation device in_which it is used for this approach at the approach list which realizes liquid crystal orientation which is different by the reflective display and the transparency display is roughly classified into three kinds, the liquid crystal display method used in the liquid crystal display concerning this invention realized according to these approaches and orientation devices is not limited especially that what is necessary is just to choose orientation change of liquid crystal from the method group used for a display suitably. Specifically as the above-mentioned liquid crystal display method used in this invention, various modes, such as for example, TN method which is the mode in which the nematic phase of a liquid crystal constituent is used for a display, a STN method, pneumatic bistability mode, vertical orientation mode, hybrid orientation mode, and ECB (electrically controlled biriefringence; electric-field control birefringence) mode, can be used. Moreover, it can use as the above-mentioned liquid crystal display method with which for example, the polymer dispersed liquid

crystal mode which is the mode in which dispersion is used, a dynamic scattering method, etc. are used in this invention. Furthermore, it is available as the above-mentioned liquid crystal display method with which the surface passivation strong dielectric liquid crystal display method using a ferroelectric liquid crystal constituent and the non-threshold switching antiferroelectric liquid crystal display method which used antiferroelectricity liquid crystal are also used in this invention in order to use orientation change for a display.

[0108] Moreover, when adopting the 3rd approach of the above, the above-mentioned liquid crystal display method used in this invention may be a method using the modulation of optical activity like TN method, may be a method using the modulation of a retardation like ECB mode, and may be a method with which the rate of the absorption of light (absorbance) is modulated like GH method. When adopting the 3rd approach of the above, including these methods, liquid crystal thickness is a method used as the main determinants of an optical property, and setting up liquid crystal thickness thickly by the transparency display, and setting up liquid crystal thickness thinly by the reflective display can adopt all the methods that have the effectiveness of good display property implementation.

[0109] The substrate of a couple with which the orientation means was given to the front face on which a liquid crystal display counters as mentioned above in this invention, It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrates of this couple. It is arbitrary and the orientation device for making it simultaneously take at least two kinds of different orientation conditions is provided to a different field used for the display in the above-mentioned liquid crystal layer. A reflective means is allotted to at least one field among the fields which show a different orientation condition in the above-mentioned liquid crystal layer. The account of a top And the reflective display to which the field which shows a different orientation condition performs a reflective display, By being used for the transparency display which performs a transparency display, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity according to the orientation condition of a liquid crystal layer can be obtained, there is no parallax, and a high contrast ratio can be realized. Consequently, while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired even when an ambient light is strong.

[0110] Moreover, when extent of the amount of modulations of each optical physical quantity, such as the amount of absorption of light and phase contrast by the optical anisotropy, is independently changed by the reflective display and the transparency display, Even when the direction of orientation of the liquid crystal by impression of an electrical potential difference is almost the same in the whole field for using for the display of a liquid crystal layer, in the field in which the liquid crystal thickness of a liquid crystal layer differs Since it has substantially the same operation as the case where the direction of orientation of a liquid crystal layer is changed in this field, the liquid crystal display concerning this invention It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrate of a couple with which the orientation means was given to the front face which counters, and the substrate of this couple. While each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display At least, a reflective means is allotted to a reflective display and the liquid crystal thickness of the above-mentioned reflective display is good for it also as a configuration set up smaller than a transparency display.

[0111] Also in the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible to set up an optical parameter independently by the transparency display and the reflective display. Therefore, according to the above-mentioned configuration, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired

even when an ambient light is strong.
[0112] Hereafter, the gestalt 1 of operation and the gestalt 2 of operation mainly explain especially the liquid crystal display that performs a good transparency display in a good reflective display list by changing liquid crystal thickness by the reflective display and the transparency display.
[0113] [The gestalt 1 of operation]
The gestalt of this operation mainly explains below the liquid crystal display which used GH method with reference to drawing 1.
[0114] Drawing 1 is the important section sectional view of the liquid crystal display concerning the gestalt 1 of this operation. This liquid crystal display is equipped with the back light 13 (lighting system) as a background lighting means if needed while it is equipped with a liquid crystal cell 100 (liquid crystal display component), as shown in drawing 1. These liquid crystal cells 100 and a back light 13 are arranged in order of the liquid crystal cell 100 and the back light 13 from the observer (user) side.
[0115] The electrode substrate 101 (the 1st substrate) with which the liquid crystal layer 1 equipped with the orientation film 2 the side (interface on the 1st substrate which touches the liquid crystal layer 1) which touches this liquid crystal layer 1 as a liquid crystal cell 100 was shown in drawing 1, It has the configuration pinched by the electrode substrate 102 (the 2nd substrate) which equipped with the orientation film 3 the side (interface on the 2nd substrate which touches the liquid crystal layer 1) which touches the liquid crystal layer 1.
[0116] The electrode 6 (electrical-potential-difference impression means) for impressing an electrical potential difference to the liquid crystal layer 1 is formed on the substrate 4 which turns into the above-mentioned electrode substrate 101 from the glass substrate which has translucency, and the orientation film 2 (orientation device) with which rubbing processing was performed is formed so that this electrode 6 may be covered.
[0117] On the other hand, the electrode 7 (electrical-potential-difference impression means) as a counterelectrode which counters an electrode 6 is formed through the insulator layer 11 at the above-mentioned electrode substrate 102 which countered the above-mentioned electrode substrate 101 and was formed on both sides of the liquid crystal layer 1 on the substrate 5 which has translucency in the liquid crystal layer 1 that an electrical potential difference should be impressed.
[0118] The above-mentioned insulator layer 11 is formed in the field corresponding to the field used for the display in the above-mentioned liquid crystal layer 1 so that it may have selectively different thickness, so that the field used for the display in the above-mentioned liquid crystal layer 1 may have at least two kinds (the gestalt of this operation two kinds) of different liquid crystal thickness. In more detail, the above-mentioned insulator layer 11 is a field corresponding to the transparency display 10, and it is formed so that thickness may become thin rather than the field corresponding to the reflective display 9.
[0119] The wrap reflective film 8 (reflective means) is formed in the field corresponding to the reflective display 9 in the above-mentioned electrode substrate 102 in the above-mentioned electrode 7, and further, the orientation film 3 (orientation device) with which rubbing processing was performed is formed in it so that the reflective film 8 may be covered in these electrode 7 list.
[0120] Here, an electrode 6-7 is a transparent electrode formed of ITO (indium tin oxide). Moreover, a display is controlled by the electrical potential difference which the electrical potential difference for making the liquid crystal layer 1 produce electric field was impressed to the electrode 6-7, and was based on the content of a display being impressed.
[0121] Moreover, the reflective film 8 has light reflex nature, for example, is produced by metals, such as aluminum and silver, the dielectric multilayer mirror, etc. When the reflective film 8 is produced with a conductor, this reflective film 8 may be holding an additional post of the function as an electrode instead of an electrode 7. That is, the reflective film 8 may be a reflective pixel electrode which serves both as the liquid crystal actuation electrode which drives the liquid crystal layer 1, and a reflective means. Furthermore, the above-mentioned reflective film 8 may be color reflective film which reflects the light

of the wavelength band suitably chosen from the light.
[0122] In addition, construction material, the formation approach, etc. of each part material which constitute the above-mentioned electrode substrate 101-102 are not necessarily limited to the above-mentioned publication, and a well-known ingredient and the approach in ordinary use can be conventionally used for them. Moreover, the configuration of the above-mentioned liquid crystal display is not limited to the above-mentioned configuration, either, and you may have directly the configuration with which an electrical potential difference is impressed to the electrode 6-7 corresponding to the reflective display 9 and the transparency display 10 from the exterior of a liquid crystal cell 100 with the signal from the touch panel (press coordinate detection blocking force means) explained with the gestalt of operation mentioned later. Moreover, you may have the configuration in which active components, such as a TFT component and MIM, are prepared as a switching element.
[0123] As the above-mentioned electrode substrate 101-102 is shown in drawing 1, the liquid crystal layer 1 is formed by carrying out opposite arrangement so that the orientation film 2-3 may counter, being stuck using an enclosure sealing compound etc., and introducing a liquid crystal constituent into the opening.
[0124] Moreover, a back light 13 is seen from an observer (user), and is arranged at the tooth-back, i.e., electrode substrate 102 rear face, side of the above-mentioned liquid crystal cell 100. This back light 13 is mainly constituted by light source 13a and transparent material 13b. Light source 13a is arranged along the side face of for example, transparent material 13b, and, thereby, transparent material 13b carries out outgoing radiation of the light which made the side face by the side of light source 13a arrangement plane of incidence, and carried out incidence from light source 13a to the liquid crystal cell 100 which is an illuminated object. In addition, the existing lighting system can be used as the above-mentioned back light 13.
[0125] In the liquid crystal display which has the above-mentioned configuration, it displays on the screen from a substrate 4, i.e., observer, side by the reflective display 9 in which the reflective film 8 was formed by controlling by change of liquid crystal orientation the reflectivity of the ambient light which carries out incidence. Moreover, in the transparency display 10 in which the reflective film 8 is not formed, it displays on the screen from a substrate 5 side by controlling by change of liquid crystal orientation the transmitted light reinforcement of the light which carries out incidence. In this case, the illumination light by the back light 13 installed in liquid crystal cell 100 tooth back may be used if needed.
[0126] The above-mentioned liquid crystal display shown in drawing 1 is produced by liquid crystal thickness which is different by the reflective display 9 and the transparency display 10 as mentioned above. Thereby, the above-mentioned liquid crystal display has liquid crystal orientation which is substantially different by the reflective display 9 and the transparency display 10.
[0127] Here, the configuration of the liquid crystal display for obtaining liquid crystal thickness which is different by the reflective display 9 and the transparency display 10 is explained below.
[0128] What is necessary is just to form so that it may have thickness which is different by the reflective display 9 and the transparency display 10 in an insulator layer 11 as shown in drawing 1 in order to obtain liquid crystal thickness which is different by the reflective display 9 and the transparency display 10.
[0129] in addition, the substrate (namely, the above-mentioned electrode substrate 101-102) with which the configuration for changing liquid crystal thickness by the reflective display 9 and the transparency display 10 is pinching liquid crystal -- at least -- either -- even having -- what is necessary is just to be
[0130] Therefore, the above-mentioned insulator layer 11 may be allotted not on the substrate 5 but on the substrate 4. However, even if it is such a case, the reflective film 8 is formed on the substrate 5 by the side of the electrode substrate 102 (namely, pinching the liquid crystal layer 1 with a screen side (electrode substrate 101 side) opposite hand).
[0131] In addition, although considered as the configuration to which liquid crystal thickness is changed

by the reflective display 9 and the transparency display 10 by changing the thickness of an insulator layer 11 in the liquid crystal display shown in drawing 1 in the field corresponding to the reflective display 9 in an insulator layer 11, and the field corresponding to the transparency display 10 It is good also as a configuration to which liquid crystal thickness is changed by the reflective display 9 and the transparency display 10 by forming a substrate 4 or substrate 5 itself in the same configuration as the insulator layer 11 shown in drawing 1.
[0132] In moreover, the field corresponding to the reflective display 9 in an insulator layer 11 and the field corresponding to the transparency display 10 When changing the thickness, as shown in drawing 1, the insulator layer 11 of the field corresponding to the transparency display 10 It is good also as a configuration by which you may form so that it may become thinner than the thickness of the insulator layer 11 of the field corresponding to the reflective display 9, or the insulator layer 11 is formed in the field corresponding to the reflective display 9, and the insulator layer 11 is not formed in the field corresponding to the transparency display 10.
[0133] Furthermore, in order to maintain the liquid crystal thickness of the liquid crystal layer 1 in the reflective display 9 and the transparency display 10 at a predetermined value, a spacer (not shown) may be arranged on the liquid crystal layer 1, and liquid crystal thickness may be maintained at the predetermined value by other technique. For example, when arranging a spherical spacer on the liquid crystal layer 1, the liquid crystal thickness in the reflective display 9 with thin liquid crystal thickness turns into thickness almost equal to the diameter of this spacer.
[0134] As mentioned above, the substrate pair 1 prepared as mentioned above, i.e., the liquid crystal layer pinched by the above-mentioned electrode substrate 101-102, consists of a liquid crystal constituent. While use the liquid crystal constituent which made dichroism coloring matter 12 mix in liquid crystal, making the liquid crystal layer 1 produce electric field and controlling [as a liquid crystal display method by this liquid crystal layer 1,] liquid crystal orientation to be shown in drawing 1, for example, the direction of orientation of dichroism coloring matter 12 can be changed simultaneously, and GH method which displays using change of the absorption coefficient by dichroism can be used.
[0135] Next, a display principle in case the liquid crystal thickness in the reflective display 9 differs from the liquid crystal thickness in the transparency display 10 is explained to actuation of the liquid crystal layer 1 by GH method, and a list below with reference to drawing 1.
[0136] When displaying using the liquid crystal display shown in drawing 1, as an arrow head shows, it displays at the transparency display 10 by passing the liquid crystal layer 1 only at once, carrying out outgoing radiation of the light from back light 13 grade and liquid crystal layer 1 back from the screen, and making it into display light. As for the dichroism coloring matter 12 mixed into the liquid crystal constituent arranged on the liquid crystal layer 1, the rate of the absorption of light changes with liquid crystal orientation at this time. for this reason, as shown in transparency display 10a, while liquid crystal is carrying out orientation (parallel orientation is called hereafter) of the transparency display 10 to parallel to the screen (electrode substrate 101) As it becomes a dark display since the dichroism coloring matter 12 in this part absorbs strongly the light which passes the liquid crystal layer 1, and shown in transparency display 10b While liquid crystal is carrying out orientation (vertical orientation is called hereafter) vertically to the screen (electrode substrate 101), since the absorption of light by dichroism coloring matter 12 is weak, it becomes clear display and a display becomes possible.
[0137] On the other hand, in the reflective display 9, the light which carried out incidence to the screen from the observer side is used for a display. That is, as an arrow head shows, after the light which carried out incidence to the screen passes the liquid crystal layer 1, it is reflected by the reflective film 8, and it passes the liquid crystal layer 1 again, it carries out outgoing radiation from the screen, and it turns into display light. As the reflective display 9 is shown in reflective display 9a at this time, while liquid crystal is carrying out parallel orientation, as it becomes a dark display since the dichroism coloring matter 12 in this part absorbs light strongly and is shown in reflective display 9b, while liquid crystal is carrying out vertical orientation, since the absorption of light by dichroism coloring matter 12

is weak, it becomes clear display and a display becomes possible.
[0138] Therefore, clear display and a dark display are attained by giving the potential difference between an electrode 6 and an electrode 7, and controlling liquid crystal orientation. In addition, when especially the initial orientation condition of liquid crystal is not limited and an electrical potential difference is not impressed [for example,] in this case, parallel orientation may be carried out, you may be twisting further, and vertical orientation may be carried out when not impressing an electrical potential difference to reverse. In the case of the former, a dielectric constant anisotropy can use forward liquid crystal for liquid crystal (namely, when the liquid crystal orientation when not impressing an electrical potential difference is parallel orientation or it is twisting further). On the other hand, in the case of the latter, as liquid crystal, a dielectric constant anisotropy can use negative liquid crystal (namely, when the liquid crystal orientation when not impressing an electrical potential difference is vertical orientation). Thus, although especially the initial orientation condition of liquid crystal is not limited, it needs to adjust the thickness of an insulator layer 11 so that the liquid crystal thickness suitable for the gestalt of the liquid crystal orientation to be used may be obtained.
[0139] Moreover, as shown in drawing 1, in order to produce the liquid crystal layer 1 easily, it is desirable to have the structure which the liquid crystal layer 1 opened for free passage over the reflective display 9 and the transparency display 10, or two or more display pixels like the usual liquid crystal display.
[0140] Thus, even if it is the case where the liquid crystal layer 1 is open for free passage between the reflective display 9 and the transparency display 10 Distance when liquid crystal thickness differs by the transparency display 10 and the reflective display 9, while display light and the becoming light pass the liquid crystal layer 1 eventually It becomes possible to set up almost similarly in the distance in which this light passes the liquid crystal layer 1 only at once in the transparency display 10, and the distance in which this light goes and comes back to the liquid crystal layer 1 in the reflective display 9.
[0141] For this reason, while the reflective lightness of the reflective display 9 and the transparency lightness of the transparency display 10 can set up almost to the same extent, the contrast ratio in the reflective display 9 and the contrast ratio in the transparency display 10 can be set up almost to the same extent. If it puts in another way, in GH method using the absorption of light by dichroism coloring matter 12, changing liquid crystal thickness by the reflective display 9 and the transparency display 10 Since there is the same effectiveness as the case where coloring matter concentration is changed, substantially, by changing liquid crystal thickness by the transparency display 10 and the reflective display 9 Mixing concentration of the dichroism coloring matter 12 suitable for the reflective display 9 to a liquid crystal constituent and mixing concentration of the dichroism coloring matter 12 suitable for the transparency display 10 can be made almost equal. Therefore, the reflective display 9 and the transparency display 10 can realize a good display simultaneously by the liquid crystal layer 1 which the reflective display 9 and the transparency display 10 are opening for free passage. That is, by the reflective display 9 and the transparency display 10, a display contrast ratio is comparable and the lightness of clear display also becomes comparable.
[0142] In addition, the lightness in this case shall show the rate observed by the observer as a display light in the reflective display 9 or the transparency display 10 among the light which carries out incidence to the liquid crystal layer 1, and a contrast ratio shall ** and define the lightness of clear display by lightness of a dark display.
[0143] Moreover, when the contrast ratio suitable for a reflective display is generally compared with the contrast ratio suitable for a transparency display, it is required that the contrast ratio suitable for a transparency display should be higher than the contrast ratio suitable for a reflective display. Therefore, in order to fill this demand, it is more effective rather than setting up equally the contrast ratio in the reflective display 9, and the contrast ratio in the transparency display 10 the liquid crystal thickness in the transparency display 10 is set up more thickly than the liquid crystal thickness in the reflective display 9, and the contrast ratio in the transparency display 10 exceeds the contrast ratio in the

reflective display 9, when performing a good display.
[0144] Although a concrete example and the example of a comparison are hereafter given and explained with reference to drawing 1 - drawing 3 about the liquid crystal display concerning the gestalt of this operation based on the display principle mentioned above, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0145] [Example 1]
By this example, by liquid crystal's carrying out orientation almost vertically to a screen normal, while not impressing the electrical potential difference to the liquid crystal layer 1, and impressing an electrical potential difference to the liquid crystal layer 1, liquid crystal inclines to the screen and the liquid crystal display with which the dielectric constant anisotropy which carries out orientation uses the liquid crystal layer 1 of GH method using negative liquid crystal for a display is explained. First, the manufacture approach of this liquid crystal display is explained below.
[0146] first, it was alike on the transparent substrate 4, and 140nm of ITO(s) was formed by sputtering, and the electrode 6 (transparent electrode) of a predetermined pattern was produced by carrying out etching processing using photolithography. In addition, the glass substrate was used as the above-mentioned substrate 4.
[0147] Next, the orientation film 2 was formed on the electrode 6 forming face in this substrate 4 by arranging the vertical orientation film by offset printing, and calcinating this in 200-degree C oven further. Then, orientation processing was performed to the orientation film 2 by rubbing, and the electrode substrate 101 as an observer side substrate was produced.
[0148] Here, the vertical orientation film has the property to which normal bearing of a film surface is made to carry out orientation of the liquid crystal, and has further the property to which abundance extent dip orientation of the liquid crystal orientation is carried out [the] from a normal by orientation processing of rubbing etc. The liquid crystal orientation after electrical-potential-difference impression inclines still more greatly toward the above-mentioned orientation processing direction for this dip.
[0149] On the other hand, the sensitization resin which has insulation was applied with the spin coat on the substrate 5, sensitization resin did not remain in the transparency display 10 by the mask exposure of ultraviolet radiation further, but in the reflective display 9, pattern formation of the insulator layer 11 was carried out so that it might be formed at the thickness this whose sensitization resin is 3 micrometers. At this time, the electrode 7 formed at an after process formed the pattern edge part of an insulator layer 11 in the level difference configuration gently-sloping enough so that plasmotomy might not be carried out by the level difference of this insulator layer 11. In addition, the substrate 4 and the same transparent glass substrate were used for the above-mentioned substrate 5.
[0150] Furthermore, 140nm of ITO(s) was formed by sputtering on the insulator layer 11 forming face in this substrate 5, and 200nm of aluminum which functions as an electrode of light reflex nature was further formed by sputtering on it. Subsequently, patterning of the obtained aluminum film was carried out by photolithography and dry etching so that this aluminum film might remain only in the reflective display 9 (namely, part which made sensitization resin remain in case patterning of the sensitization resin was carried out that an insulator layer 11 should be formed), and the reflective film 8 was formed. And the electrode 7 (transparent electrode) of a predetermined pattern was further produced by carrying out etching processing of the lower layer ITO film of this reflective film 8 using photolithography.
[0151] Next, the orientation film 3 was formed by the same approach as the orientation film 2 of the above-mentioned electrode substrate 101 which is an observer side substrate on the above-mentioned electrode 7 in this substrate 5, and the reflective film 8 forming face. Then, orientation processing was performed to the above-mentioned orientation film 3 by rubbing, and the electrode substrate 102 was produced.
[0152] Among the electrode substrates 101-102 produced as mentioned above, around one electrode substrate, the seal resin (not shown) as an enclosure sealing compound was arranged, on the orientation film forming face in the electrode substrate of another side, as a spherical plastic spacer with a diameter

of 4.5 micrometers was sprinkled and it was shown in drawing 1, the electrode surface was made to counter, seal resin was hardened under application of pressure, and the liquid crystal cell for liquid crystal impregnation was produced. When the thickness (namely, thickness of the liquid crystal layer 1) of the opening for liquid crystal impregnation in the reflective display 9 and the transparency display 10 of a liquid crystal cell for this liquid crystal impregnation was measured by measurement of a reflected light spectrum, in the reflective display 9, it was 7.5 micrometers at 4.5 micrometers and the transparency display 10.

[0153] Furthermore, when the dielectric constant anisotropy introduced into the liquid crystal cell for the above-mentioned liquid crystal impregnation the liquid crystal constituent which comes to mix dichroism coloring matter 12 in negative liquid crystal, the concentration of dichroism coloring matter 12 was adjusted to concentration from which sufficient contrast ratio is obtained by the reflective display 9 and the transparency display 10. Furthermore, the chiral additive which gives a twist to the orientation of liquid crystal was added to the above-mentioned liquid crystal constituent, and with the orientation processing performed to the orientation film 2-3, by the reflective display 9 and the transparency display 10 in an electrical-potential-difference impression condition which are used for a dark display, the twist of the liquid crystal orientation between the electrode substrates 101.102 of the upper and lower sides of the liquid crystal layer 1 set it as it so that it might become the same. Furthermore, the liquid crystal constituent was introduced into the liquid crystal cell for the above-mentioned liquid crystal impregnation by the vacuum pouring-in method, and the liquid crystal display was produced.

[0154] When the electrical potential difference was impressed to the liquid crystal layer 1, measuring the reflection factor of the reflective display 9 in the obtained liquid crystal display, and the permeability of the transparency display 10 under a microscope, the display property shown in drawing 2 was acquired. The electrical potential difference impressed to the liquid crystal layer 1 is a square wave currently inverted every 17msec., in drawing 2, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, in this drawing, a curve 111 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9, and a curve 112 shows the electrical-potential-difference dependency of the permeability of the transparency display 10.

[0155] As shown in a curve 111 and a curve 112, in the above-mentioned liquid crystal display, the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is both falling with impression of an electrical potential difference. Moreover, when applied voltage was 1.8V, the reflection factor of the reflective display 9 was 55%, the permeability of the transparency display 10 was 52%, and when applied voltage was 5V, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 was 10% 11%.

[0156] That is, according to the above-mentioned liquid crystal display, while the high value to which the lightness of clear display both exceeds 50% also to the transparency display 10 is shown also to the reflective display 9, a contrast ratio is about 5, and the display excellent in visibility was able to be realized.

[0157] [The example 1 of a comparison]

Here, the example of a comparison of the above-mentioned example 1 is shown. In this example 1 of a comparison, the liquid crystal display for a comparison was produced according to the manufacture approach of the liquid crystal display shown in an example 1 in the liquid crystal display using GH method shown in an example 1 except having designed so that the liquid crystal thickness in the reflective display 9 and the liquid crystal thickness in the transparency display 10 might become the same.

[0158] In this example of a comparison, the insulator layer 11 which was produced on the substrate 5 of an example 1 was not produced, but, more specifically, both the liquid crystal thickness in the reflective display 9 and the liquid crystal thickness in the transparency display 10 produced the liquid crystal display which is 4.5 micrometers. That is, the electrode substrate of the upper and lower sides which

counter on both sides of the liquid crystal layer 1 produced the liquid crystal display by both producing the smooth liquid crystal cell for liquid crystal impregnation by the reflective display 9 and the transparency display 10, and introducing the liquid crystal constituent which mixed the same dichroism coloring matter 12 and same chiral additive as an example 1 in the liquid crystal cell for this liquid crystal impregnation.
[0159] The display property which measured the reflection factor of the reflective display 9 and the permeability of the transparency display 10 in the obtained liquid crystal display by the same approach as an example 1, and was acquired is shown in drawing 3.
[0160] [The example 2 of a comparison]
In this example 2 of a comparison, the liquid crystal display set as the same liquid crystal cell as the example 1 of a comparison so that the liquid crystal constituent which made concentration of dichroism coloring matter 12 high might be introduced and the lightness and the contrast ratio of the transparency display 10 might become the optimal from the example 1 of a comparison was produced.
[0161] The display property which measured the reflection factor of the reflective display 9 and the permeability of the transparency display 10 in the obtained liquid crystal display by the same approach as an example 1, and was acquired is combined with the result of the example 1 of a comparison, and is shown in drawing 3.
[0162] In drawing 3, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, in this drawing, a curve 121 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 of the example 1 of a comparison, and a curve 122 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 of the example 1 of a comparison. Moreover, a curve 123 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 of the example 2 of a comparison, and a curve 124 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 of the example 2 of a comparison.
[0163] As shown in a curve 121 and a curve 122, although the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is falling with impression of an electrical potential difference, with the liquid crystal display obtained in the example 1 of a comparison, both The permeability of the transparency display 10 was 66% to the reflection factor of the reflective display 9 in case applied voltage is 1.8V having been 51%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 22% 11%.
[0164] That is, according to the liquid crystal display obtained in the above-mentioned example 1 of a comparison, in the reflective display 9, although the high lightness exceeding 50% and about five contrast ratio were obtained, since the liquid crystal thickness in this transparency display 10 was the same as the liquid crystal thickness in the reflective display 9 in the transparency display 10, although the lightness of the liquid crystal layer 1 was high, the contrast ratio was as low as about three, and display grace was low.
[0165] Moreover, both, as shown in a curve 123 and a curve 124, although the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is falling with lowering of an electrical potential difference, with the liquid crystal display obtained in the example 2 of a comparison The permeability of the transparency display 10 was 51% to the reflection factor of the reflective display 9 in case applied voltage is 1.8V having been 29%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 10% 3%.
[0166] That is, according to the liquid crystal display obtained in the above-mentioned example 2 of a comparison, although the high lightness exceeding 50% and about five contrast ratio were obtained, since the liquid crystal thickness in this reflective display 9 was the same as the liquid crystal thickness in the transparency display 10 in the reflective display 9, although the contrast ratio was as high as about ten,

lightness did not fill it with the transparency display 10 to 30%, but it became a dark display by it.
[0167] clear from the comparison with the above-mentioned example 1 and the example 1-2 of a comparison -- as -- the liquid crystal display of GH method -- setting -- the contrast ratio of the transparency display 10 -- the contrast ratio and EQC of the reflective display 9 -- or in order to have made it higher, it turned out that it is effective to set up more greatly than the thickness of the liquid crystal layer 1 of the reflective display 9 the thickness of the liquid crystal layer 1 of the transparency display 10.
[0168] [The gestalt 2 of operation]
As a liquid crystal display method concerning this invention, although the gestalt 1 of said operation explained the liquid crystal display which used GH method, as shown in drawing 4, a substrate 4-5 may be pinched with a polarizing plate 14-15, and the method which uses the retardation and rotatory polarization (it is hereafter written as a polarization conversion operation collectively) of the liquid crystal layer 1 for a display may be adopted besides the above-mentioned GH method.
[0169] So, the gestalt of this operation mainly explains below the liquid crystal display which used the above-mentioned polarization conversion operation for the display with reference to drawing 4. In addition, the same number is given to the component which has the function as the gestalt 1 of said operation of explanation same for convenience, and the explanation is omitted.
[0170] Drawing 4 is the important section sectional view of the liquid crystal display concerning the gestalt of this operation. The liquid crystal display shown in drawing 4 is equipped with said back light 13 (lighting system) if needed while it is equipped with a liquid crystal cell 200 (liquid crystal display component). These liquid crystal cells 200 and a back light 13 are arranged in order of the liquid crystal cell 200 and the back light 13 from the observer (user) side.
[0171] The electrode substrate 201 (the 1st substrate) with which the liquid crystal layer 1 equipped with the orientation film 2 the side (interface on the 1st substrate which touches the liquid crystal layer 1) which touches this liquid crystal layer 1 as a liquid crystal cell 200 was shown in drawing 4, It is pinched by the electrode substrate 202 (the 2nd substrate) which equipped with the orientation film 3 the side (interface on the 2nd substrate which touches the liquid crystal layer 1) which touches the liquid crystal layer 1. Furthermore, while equipping the outside (namely, the opposed face with the electrode substrate 202 opposite hand) of the electrode substrate 201 with the phase contrast compensating plate 16 and a polarizing plate 14 It has the configuration which equipped the outside (namely, the opposed face with the electrode substrate 201 opposite hand) of the electrode substrate 202 with the phase contrast compensating plate 17 and the polarizing plate 15. In addition, the above-mentioned phase contrast compensating plate 16-17 is used if needed, being prepared.
[0172] Various phase contrast compensating plates, such as a drawing high polymer film, a liquid crystal orientation fixed high polymer film, and a liquid crystallinity high polymer film, can be used for the above-mentioned phase contrast compensating plate 16-17 used if needed in this invention. The optical operation is used for modification of the dependency of the lightness over prevention of the coloring often seen and the potential difference of an electrode 6-7, and a pan for modification of a display angle of visibility etc., when it does not have the phase contrast compensating plate 16-17 used.
[0173] Moreover, the electrode 6 for impressing an electrical potential difference to the liquid crystal layer 1 is formed on the substrate 4 which turns into the above-mentioned electrode substrate 201 from the glass substrate which has translucency, and the orientation film 2 with which rubbing processing was performed is formed so that this electrode 6 may be covered.
[0174] On the other hand, the electrode 7 as a counterelectrode which counters an electrode 6 is formed through the insulator layer 11 at the above-mentioned electrode substrate 202 which countered the above-mentioned electrode substrate 201 and was formed on both sides of the liquid crystal layer 1 on the substrate 5 which has translucency in the liquid crystal layer 1 that an electrical potential difference should be impressed. However, in the liquid crystal display shown in drawing 4, it has a configuration to which the electrode 7 in the reflective display 9 and the electrode 7 in the transparency

display 10 are insulated electrically, and an electrical potential difference is independently impressed from the liquid crystal cell outside. And the reflective film 8 is formed in the field corresponding to the reflective display 9 in the above-mentioned electrode substrate 202, and further, the orientation film 3 with which rubbing processing was performed is formed in it so that the reflective film 8 may be covered in these electrode 7 list. Moreover, the above-mentioned insulator layer 11 is formed so that the thickness of the field corresponding to the transparency display 10 in this insulator layer 11 may become thinner than the thickness of the field corresponding to the reflective display 9.
[0175] As the above-mentioned electrode substrate 201-202 is shown in drawing 4, the liquid crystal layer 1 is formed by carrying out opposite arrangement so that the orientation film 2 and the orientation film 3 may counter, being stuck using an enclosure sealing compound etc., and introducing a liquid crystal constituent into the opening.
[0176] In the above-mentioned liquid crystal display, the liquid crystal layer 1 which consists of a liquid crystal constituent mentioned above has the structure which was open for free passage between the reflective display 9 and the transparency display 10 in clear display. In drawing 4, as shown in reflective display 9b and transparency display 10b, while carrying out parallel orientation of the liquid crystal of this liquid crystal layer 1, a polarization conversion operation arises to the light which passes the liquid crystal layer 1, and it serves as a dark display. On the other hand, as shown in reflective display 9a and transparency display 10a, while the liquid crystal of the liquid crystal layer 1 is carrying out vertical orientation, a polarization conversion operation is weak and serves as clear display.
[0177] Therefore, clear display and a dark display are attained by using the orientation change in reflective display 9aand9b, and transparency display 10a and 10b for a display as display luminous-intensity change in the linearly polarized light selection transparency operation by the polarizing plate 14 by the side of the screen which pinches the liquid crystal layer 1 and is arranged, and the polarizing plate 15 by the side of a back light 13. In addition, as mentioned above, in order to compensate the wavelength dependency of the refractive-index difference of the liquid crystal layer 1 in this case, in order to change the electrical-potential-difference dependency of the lightness modulated in the liquid crystal layer 1 if needed, or in order to change the angle of visibility of a display, the phase contrast compensating plate 16-17 as shown in drawing 4 may be used.
[0178] Thus, also when using an optical anisotropy for a display, especially the initial orientation condition of liquid crystal may not be limited, may be in the condition in which the liquid crystal layer 1 in electrical-potential-difference the condition of not impressing carried out orientation to parallel to the screen, and may be in the condition which carried out orientation vertically. In the case of the former, a dielectric constant anisotropy can use forward liquid crystal for liquid crystal (namely, when the liquid crystal orientation in electrical-potential-difference the condition of not impressing is parallel orientation). On the other hand, in the case of the latter, as liquid crystal, a dielectric constant anisotropy can use negative liquid crystal (namely, when the liquid crystal orientation in electrical-potential-difference the condition of not impressing is vertical orientation).
[0179] Thus, also when using an optical anisotropy for a display, it is effective [a condition], although especially the initial orientation condition of liquid crystal is not limited to adjust the thickness of an insulator layer 11 so that the liquid crystal thickness suitable for the gestalt of the liquid crystal orientation to be used may be obtained.
[0180] In order to realize a dark display by the above-mentioned reflective display 9, the light made into the linearly polarized light with the polarizing plate 14 is prepared first. And if needed, with the phase contrast compensating plate 16, a polarization condition is changed, and rather than the transparency display 10, thickness is the liquid crystal layer 1 of the reflective display 9 set up thinly, and changes a polarization condition further. this time -- conditions required for an ideal dark display -- as a result -- the polarization condition on the reflective film 8 -- right and left -- it is considering as the circular polarization of light which may be the surroundings of which. Moreover, conditions required in order to realize ideal clear display by the same reflective display 9 are making the polarization condition on the

reflective film 8 into the linearly polarized light. And the change of a display will be attained if liquid crystal orientation is electrically controllable between this dark display and clear display.
[0181] That is, the phase contrast which the liquid crystal layer 1 will give to light by the time the light which carried out incidence to the liquid crystal layer 1 reaches the reflective film 8, when realizing a dark display (phase contrast of the display light on the reflective film 8), Between the phase contrast (phase contrast of the display light on the reflective film 8) which the liquid crystal layer 1 will give to light by the time the light which carried out incidence to the liquid crystal layer 1 reaches the reflective film 8, when realizing clear display the liquid crystal orientation which there is a difference in quarter-wave length (in general 90 degrees) substantially, and realizes it -- for example, between the circular polarization of light [in / electrically / controllable, i.e., a dark display,], and the linearly polarized lights in clear display -- controllable -- ****ing . At this time, polarization bearing of the linearly polarized light on the reflective film 8 which realizes clear display is good in the bearing of arbitration.
[0182] Moreover, a display is performed by making it change in the liquid crystal layer 1 with which the light made into the linearly polarized light with the polarizing plate 15 in the transparency display 10 changed the polarization condition with the phase contrast compensating plate 17 if needed, and thickness was subsequently thickly set up rather than the reflective display 9, making it change with phase contrast compensating plates 16 further if needed, and carrying out outgoing radiation from a polarizing plate 14.
[0183] In this case, it is change of a polarization condition just before carrying out incidence to a polarizing plate 14 which is used for a display. Therefore, what is necessary is just to adjust a polarization condition just before carrying out incidence to a polarizing plate 14 that what is necessary is just to adjust a polarization condition just before carrying out incidence to a polarizing plate 14 so that it may become the linearly polarized light which has the oscillating direction of transparency shaft bearing of a polarizing plate 14 in performing clear display, so that it may become the linearly polarized light which has the plane of vibration of absorption shaft bearing of a polarizing plate 14 in performing a dark display.
[0184] That is, the phase contrast given to the light which passes the liquid crystal layer 1 of the transparency display 10 when performing clear display (phase contrast of the display light which carries out outgoing radiation of the liquid crystal layer 1), A difference with the phase contrast (phase contrast of the display light which carries out outgoing radiation of the liquid crystal layer 1) given to the light which passes the liquid crystal layer 1 of the transparency display 10 when performing a dark display It is possible to change a display, if change of the orientation of the liquid crystal layer 1 is electrically controlled by impression of an electrical potential difference to become 1/2 wave (in general 180 degrees) substantially.
[0185] Are equivalent to controlling polarization bearing of the linearly polarized light which carries out incidence to a polarizing plate 14 from the liquid crystal layer 1 side with 1/2 wave of phase control here. It is the polarization conversion operation not only including control of the phase contrast by the retardation in which the refractive-index main shaft carried out orientation to parallel uniformly but the rotatory-polarization phenomenon in which the refractive-index main shaft of the liquid crystal layer 1 is twisted in connection with a twist of liquid crystal orientation, and polarization bearing of the linearly polarized light changes with change by the electrical potential difference of a twist of the orientation etc. When a polarization conversion operation of the liquid crystal layer 1 which realizes this also takes into consideration application of the phase contrast compensating plate 16 or the phase contrast compensating plate 17, it is a polarization conversion operation between the general polarization conditions which intersected perpendicularly.
[0186] The liquid crystal orientation which enables the polarization conversion operation which realizes control (phase control of light) of the above polarization conditions You may be parallel (it is parallel to the screen), and uniform parallel orientation (homogeneous orientation) at a substrate 4-5. You may be the orientation (twist orientation) twisted to the substrate 4-5 between parallel (it is parallel to the

screen), and a substrate 4-5 (between the vertical substrates which countered on both sides of the liquid crystal layer 1), and may be vertical orientation (homeotropic orientation) vertical (vertical to the screen) to a substrate 4-5. Furthermore, one interface of the liquid crystal layer 1 is parallel orientation, and the hybrid orientation whose another side is vertical orientation is available.

[0187] In this case, it is desirable for it to be set as 60 degrees or more and 100 degrees or less between the above-mentioned substrates 4-5, or to specifically be set as 0 times or more and 40 degrees or less as the above-mentioned twist orientation. Even if this reason does not change rubbing bearing by the transparency display 10 and the reflective display 9, it is because it becomes possible to reconcile the conditions suitable for the conditions suitable for the reflective display 9, and the transparency display 10.

[0188] When mass-producing a liquid crystal display, it is the design which changes as an optical design of the most desirable liquid crystal layer 1 between the upper limits of the range of driver voltage and minimums which are impressed to the liquid crystal layer 1 so that display lightness (a reflection factor or permeability) may monotonous-increase or monotonous decrease.

[0189] When taking the conditions of the above actuation into consideration, the optical design of the simplest liquid crystal layer 1 is a design by which the electro-optics property that a display is controlled between the liquid crystal which carried out orientation to the screen vertically substantially, and the liquid crystal which carried out orientation to parallel substantially at the screen so that display lightness increases [monotonous-] or decreases [monotonous-] is attained.

[0190] In this case, when the parallel orientation film is used and liquid crystal orientation parallel to the screen as non-impressed electrical-potential-difference liquid crystal orientation is realized especially, the conditions suitable for a reflective display and the conditions suitable for a transparency display exist clearly. Then, it is the so-called Jones about this condition. It asked by count by the matrix method, and asked for the range where a twist angle is suitable.

[0191] Consequently, in order to obtain a good display by reflective display, it became clear that the twist angle needs to be set as 0 times or more and 100 degrees or less.

[0192] that is, an invention-in-this-application person etc. first in the liquid crystal layer 1 which realizes a good display in a reflective display In order to find out that the operation which changes the circular polarization of light into the linearly polarized light efficiently is required in the liquid crystal orientation (it is substantially equal to the liquid crystal orientation in [electrical-potential-difference] not impressing when the parallel orientation film is used) which has a polarization conversion operation and to evaluate this It asked for the reflection factor at the time of carrying out incidence of the circular polarization of light to the liquid crystal layer 1 with the above-mentioned numerical orientation method. In addition, count asked for the reflection factor of the light to which incidence was carried out to the liquid crystal cell 200 at the order of the phase contrast compensating plate 16 which gives the phase contrast of 14 or 90 polarizing plates, the liquid crystal layer 1, and the reflective film 8, and light spread from the reflective film 8 to the polarizing plate 14 conversely, and carried out outgoing radiation of this.

[0193] Consequently, it became clear by adjusting the refractive-index difference (deltan) of the liquid crystal of the liquid crystal layer 1, and a product (deltan-d) with liquid crystal thickness (d) for every twist angle of the liquid crystal layer 1 for a twist angle to be able to change the circular polarization of light into the perfect linearly polarized light within the limits of 0 times or more and 70 degrees or less. Moreover, although the circular polarization of light could not be made into the perfect linearly polarized light by within the limits to 100 degrees more than 70 degrees, the good display found out the possible thing. and a twist angle [in / by adjusting deltan-d of the liquid crystal layer 1 for every twist angle, when a twist angle makes 100% maximum in the visible wavelength of the reflection factor to 70 degrees / specific wavelength] -- 97%, 83%, a twist angle becomes 72% and, as for the reflection factor in 80 degrees, a twist angle can obtain a good reflection factor for the reflection factor in 100 degrees, as for the reflection factor in 90 degrees. However, if a twist angle exceeds 100 degrees, as for the reflection

factor in 110 degrees, a twist angle will become unable [angle] for 54% and a twist angle to become 37% in the reflection factor in 120 degrees, and to polarize the circular polarization of light efficiently to the linearly polarized light, for example. That is, it is required to set up a twist angle within the limits of 0 times or more and 100 degrees or less in the liquid crystal layer 1 in the reflective display 9.
[0194] In addition, in the above-mentioned explanation, in order to evaluate a polarization conversion operation of the liquid crystal layer 1 in the reflective display 9, the circular polarization of light was used for count, but in a actual display, even if it is not necessary to necessarily carry out incidence of the circular polarization of light to the liquid crystal layer 1 of the reflective display 9, it designs as the liquid crystal layer 1 was mentioned above, and it carries out incidence of the linearly polarized light to this liquid crystal layer 1, a good display can be obtained by the reflective display 9.
[0195] On the other hand, in order to obtain a good display by the transparency display 10, liquid crystal orientation needs to be the orientation where a twist angle is small (0 times or more, 40 degrees or less), or needs to be the orientation where a twist angle is large (60 degrees or more, 110 degrees or less).
[0196] A polarization conversion operation required in order to obtain a good display by the transparency display 10 needs to fulfill a fundamental optical operation (the 1st condition) and the realistic optical operation (the 2nd condition) decided by relation of this fundamental optical operation (the 1st condition) and the reflective display 9.
[0197] In the case of for example, the 1st condition of the above, the reason is liquid crystal orientation (when the parallel orientation film is used) which has a polarization conversion operation. Set for it to be made [orientation / in / electrical-potential-difference / not impressing] substantial, and be, and in the liquid crystal layer 1 in the transparency display 10 A certain polarization (polarization as which it is the linearly polarized light, the circular polarization of light, or elliptically polarized light, and the polarization condition was specified) Polarization which is efficient and intersects perpendicularly with it (in the case of the circular polarization of light and elliptically polarized light which the hand of cut reversed when it was the linearly polarized light and the circular polarization of light the circular polarization of light and the field where the oscillating electric field of light are included cross at right angles in the case of the linearly polarized light, it is the elliptically polarized light of the same ovality the ovality and ellipse main shaft bearing crossed at right angles) It is because the operation changed into the elliptically polarized light which the hand of cut reversed is needed.
[0198] Then, in order that an invention-in-this-application person etc. might evaluate the above-mentioned operation as a property required for the transparency display 10, the polarization conversion operation was searched for with the above-mentioned numerical orientation method (Jones matrix method), but [for this reason] if contrary to the range of a required twist angle, especially the limit became clear [that there is nothing].
[0199] Moreover, the 2nd condition of the above is constraint produced in order to use the optical film by the side of the common screen (a polarizing plate 14 and phase contrast compensating plate 16) by the reflective display 9 and the transparency display 10 in this invention. The optical film in the reflective display 9 and the transparency display 10 is set up so that a reflective display may be performed good. And although setting out of a different optical film is possible in the screen of a liquid crystal display, and the field of reverse, as for this optical film, it is desirable to set it as arrangement which cooperates with the above-mentioned polarizing plate 14 and the phase contrast compensating plate 16 which are an optical film by the side of the screen, and the liquid crystal layer 1 by the side of the transparency display 10, and indicates the transparency display 10 good. In order to perform such setting out, it is only important for a polarization conversion operation of the liquid crystal layer 1 in the transparency display 10 it not only fulfills the 1st condition of the above, but that the circular polarization of light is convertible for the circular polarization of light of the circumference of reverse good or that the linearly polarized light is convertible for the linearly polarized light which intersects perpendicularly good.
[0200] Then, in order to evaluate the concrete conditions with which the 2nd condition of the above

over the liquid crystal layer 1 in the transparency display 10 is filled, when incidence of the circular polarization of light was carried out to the liquid crystal layer 1, it asked for the luminous intensity which becomes the circular polarization of light of the circumference of reverse with the above-mentioned numerical orientation method. Count in addition, light As 1st phase contrast compensating plate which gives the phase contrast of 15 or 90 polarizing plates as the 1st polarizing plate It asked for the permeability at the time of spreading at least ** in order of the phase reference compensating plate 17, the phase contrast compensating plate 16 as 2nd phase contrast compensating plate which has the lagging axis which intersected perpendicularly with the 1st phase contrast compensating plate which gives the phase contrast of 1 or 90 liquid crystal layers, and the polarizing plate 14 as the 1st polarizing plate of the above, and the 2nd polarizing plate which intersects perpendicularly.

[0201] Consequently, the invention-in-this-application person etc. found out that the circular polarization of light was changed into the circular polarization of light of the circumference of reverse good, when deltan-d of the liquid crystal layer 1 was adjusted for every twist angle and a twist angle was within the limits of 0 times or more and 40 degrees or less. When the permeability of the light in the visible wavelength at the time of zero twist angle is specifically made into 100%, A twist angle the permeability of light in case the permeability of light in case a twist angle is 30 degrees is 40 degrees 88.6% 80.8%, The permeability of light in case 72.0% and the twist angle of the permeability of light in case a twist angle is 50 degrees are 60 degrees becomes 62.4%, and when permeability estimates the polarization conversion operation which changes the circular polarization of light into the circular polarization of light of the circumference of reverse, permeability falls with buildup of a twist angle. For this reason, the upper limit of a twist angle obtained the conclusion that setting to about 40 degrees was appropriate from the above-mentioned result.

[0202] A twist angle is a twist angle of the arbitration of 0 times or more, and setting out of the twist angle of the transparency display 10 which changes the linearly polarized light into the linearly polarized light which intersects perpendicularly efficiently on the other hand can realize fully efficient permeability, when the wavelength of light is limited to one wavelength. However, in order to obtain high permeability in the field where visible wavelength is large, an optimum value exists in a twist angle. When a twist angle is changed, deltan-d of the liquid crystal layer 1 was specifically adjusted so that 550nm which is the main wavelength of the visible wavelength range may become the maximum permeability, and the permeability of 550nm was made into 100%, it asked for the wavelength width of face except the upper limit and minimum of wavelength from which 90% or more of permeability is obtained. In addition, count of permeability is arranged so that, as for the transparency shaft of a polarizing plate 14-15, the liquid crystal orientation which exists in the center of the direction of thickness of the liquid crystal layer 1 when light passes the polarizing plate 14 as the polarizing plate 15 as the 1st polarizing plate of the above, the liquid crystal layer 1, the 1st polarizing plate, and the 2nd polarizing plate that intersects perpendicularly may make the angle of 45 degrees, and it is asking for the permeability at that time.

[0203] Wavelength width of face (wavelength range) in case a twist angle is 0 times Consequently, 230nm, 235nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 10 degrees is 20 degrees 240nm, 245nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 30 degrees is 40 degrees 250nm, 255nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 50 degrees is 60 degrees 265nm, 280nm and a twist angle wavelength width of face in case wavelength width of face in case a twist angle is 70 degrees is 80 degrees 310nm, Wavelength width of face in case 255nm and the twist angle of wavelength width of face in case 305nm and the twist angle of wavelength width of face in case 330nm and the twist angle of wavelength width of face in case a twist angle is 90 degrees are 100 degrees are 110 degrees are 120 degrees was set to 210nm.

[0204] The above examination showed that realized by wavelength width of face (wavelength range) with large permeability with a twist angle high within the limits of 60 degrees or more and 110 degrees or less, a good polarization conversion operation was realized, and a good display was attained. Therefore, the

twist angle of the liquid crystal of the transparency display 10 which fulfills the 2nd condition of the above is limited within the limits of 0 times or more and 40 degrees or less, or within the limits of 60 degrees or more and 110 degrees or less from the polarization conversion operation over the above circular polarization of light, and the polarization conversion operation over the linearly polarized light.
[0205] It became clear that the twist angle within the limits of 0 times or more and 40 degrees or less or within the limits of 60 degrees or more and 110 degrees or less gives a good display to the transparency display 10 as mentioned above at the reflective display 9 within the limits of 0 times or more and 100 degrees or less. That is, as a twist angle for obtaining a good display by both the reflective display 9 and the transparency display 10 as an example of the gestalt of operation of this invention, within the limits of 0 times or more and 40 degrees or less or within the limits of 60 degrees or more and 100 degrees or less is suitable.
[0206] In addition, in the example shown below, it sets for an example (an example 2 – an example 9, and example 11) with the equal twist angle of the liquid crystal layer 1 in the reflective display 9 and the transparency display 10. The typical example for which a twist angle uses the circular polarization of light at 0 times is an example 11 (liquid crystal orientation is vertical orientation), and the typical example for which a twist angle uses the linearly polarized light at 0 times is an example 3 (it is adjusting so that it may become good clear display with a phase contrast compensating plate). Moreover, the typical example for which a twist angle uses the linearly polarized light near 70 degrees is an example 5 (it is adjusting so that it may become good clear display with a phase contrast compensating plate).
[0207] According to examination mentioned above, the twist angle of the liquid crystal layer 1 for both obtaining a good display by the reflective display 9 and the transparency display 10 becomes within the limits of 0 times or more and 40 degrees or less, or within the limits of 60 degrees or more and 100 degrees or less.
[0208] In the above explanation, although the magnitude of a twist angle was explained only about the forward sign, it cannot be overemphasized that the same argument is effective also about the negative sign (that to which the twist direction is twisted conversely) with the same absolute value.
[0209] When setting up a twist angle small, also in any function of the product (deltan-d) of a refractive-index difference (deltan) and liquid crystal thickness (d) or case, change of a polarization condition becomes. And in the reflective display 9, since incident light goes and comes back to the liquid crystal layer 1 and incident light passes the liquid crystal layer 1 only at once in the transparency display 10, as for the liquid crystal thickness in the transparency display 10, it is desirable to be thickly set up as compared with the liquid crystal thickness in the reflective display 9.
[0210] In addition, also in TN liquid crystal display using the usual rotatory polarization, since it will be in the condition that the rotatory polarization and change of the polarization condition by the retardation are undistinguishable and generally uses elliptically polarized light for a display when liquid crystal thickness is thin, it is needless to say that it can use for the clear display and the dark display using the polarization conversion operation which mentioned above the rotatory polarization used in the above-mentioned TN liquid crystal display. The modulation of the transmitted light reinforcement by these rotatory polarization is also included in the polarization conversion operation in this invention.
[0211] furthermore, in the above-mentioned polarization conversion operation, for change of the liquid crystal orientation to which a polarization condition may be changed As mentioned above, whether the orientation condition of liquid crystal is parallel to a substrate 4-5, or vertical like not only a thing but the surface passivation ferroelectric liquid crystal to control, or antiferroelectricity liquid crystal That from which only the direction of orientation changes while liquid crystal had maintained orientation bearing almost parallel to a substrate 4-5, and the thing to which orientation bearing is changed, using a pneumatic liquid crystal, changing electrode structure, and maintaining the direction of orientation of liquid crystal in a field parallel to the screen are also contained.
[0212] Moreover, in the above-mentioned liquid crystal display, installation bearing (pasting bearing) of a polarizing plate 14-15 can be set up suitably. For example, what is necessary is just to appoint

installation bearing of a polarizing plate 15 according to installation bearing of this polarizing plate 14, in order that the same polarizing plate 14 may act inevitably also to the display light which penetrates the transparency display 10, if installation bearing of a polarizing plate 14 is set up according to the reflective display 9.

[0213] As mentioned above, when liquid crystal orientation without a twist was used for a display and the reflective display 9 showed for example, a dark display, the dark display was shown similarly [the transparency display 10]. However, for example, if installation bearing of a polarizing plate 14 remains as it is and installation bearing of a polarizing plate 15 is changed 90 degrees, reversal of a display will take place by the reflective display 9 and the transparency display 10. That is, a good display is not obtained if it remains as it is. So, in order to prevent reversal of such a display, the electrode which returned installation bearing of a polarizing plate 15, or became independent respectively to the reflective display 9 and the transparency display 10 may be given, the electric actuation itself may be reversed by either the reflective display 9 or the transparency display 10, and the light and darkness of a display may be made in agreement.

[0214] Next, the display principle in the reflective display 9 and the transparency display 10 in the liquid crystal display shown in drawing 4 is further explained to a detail.

[0215] First, the display principle in the reflective display 9 is explained below. In addition, in order to simplify explanation, by the following explanation, the liquid crystal orientation of the liquid crystal layer 1 shall not have the twist by reflective display 9b and transparency display 10b, without using the phase contrast compensating plate 16-17. Furthermore, respectively, when light with a wavelength of 550nm penetrates the liquid crystal layer 1 only once, reflective display 9b and transparency display 10b so that it may have quarter-wave length and 1/2 wave of phase contrast The thickness of the reflective display 9 and the transparency display 10 shall be adjusted, a liquid crystal constituent shall have a forward dielectric constant anisotropy, the liquid crystal orientation in [electrical-potential-difference] not impressing shall be parallel in general to a substrate 4-5, and, as for the orientation bearing, the include angle of 45 degrees shall be made to absorption shaft bearing of a polarizing plate 14.

[0216] In this case, the liquid crystal orientation in the reflective display 9 and the transparency display 10 in electrical-potential-difference the condition of not impressing turns into liquid crystal orientation shown in reflective display 9b and transparency display 10b, and the liquid crystal orientation in the reflective display 9 and the transparency display 10 which changed with impression of an electrical potential difference turns into liquid crystal orientation shown in reflective display 9a and transparency display 10a.

[0217] As for the refractive-index difference (deltan) of a liquid crystal constituent, and the product (deltan-d) with liquid crystal thickness (d), quarter-wave length conditions are satisfied in above-mentioned reflective display 9b. For this reason, in the case of incidence, an ambient light turns into the linearly polarized light with a polarizing plate 14, and further, when reaching the reflective film 8 by the retardation of the liquid crystal layer 1, it turns into the circular polarization of light. At this time, a travelling direction reverses incident light by the reflective film 8, and the circular polarization of light turns into the circular polarization of light which intersected perpendicularly to the polarization at the time of incidence, i.e., the circular polarization of light which right and left reversed, in order that the hand of cut of oscillating electric field may be saved and only a travelling direction may be reversed. This circular polarization of light passes the liquid crystal layer 1 of reflective display 9b again, turns into the linearly polarized light parallel to absorption shaft bearing of a polarizing plate 14, is absorbed with a polarizing plate 14 and serves as a dark display.

[0218] Moreover, as for the refractive-index difference (deltan) of a liquid crystal constituent, and the product (deltan-d) with liquid crystal thickness (d), in transparency display 10b, 1/2-wave conditions are satisfied at this time. For this reason, the liquid crystal layer 1 has the operation which changes into axial symmetry bearing of the plane of vibration of the linearly polarized light which carried out incidence to the direction of liquid crystal orientation. Therefore, it is determined that absorption shaft bearing of

the polarizing plate 15 by the side of the incidence of the light to transparency display 10b will become transparency shaft bearing of a polarizing plate 14 and a polarizing plate 15 and parallel as the light which passes a polarizing plate 14 is absorbed with a polarizing plate 14 and serves as a dark display in response to the operation which the liquid crystal layer 1 mentioned above.

[0219] Thus, when those transparency shaft bearings had been arranged so that a polarizing plate 14 and a polarizing plate 15 might make the include angle this transparency shaft bearing to parallel and whose liquid crystal orientation are 45 degrees, it turned out that both reflective display 9b and transparency display 10b become a dark display.

[0220] Next, the operation at the time of changing the orientation condition of liquid crystal from electrical-potential-difference the condition of not impressing (initial orientation condition of liquid crystal) shown in above-mentioned reflective display 9b and transparency display 10b almost vertically to the screen by giving the potential difference to an electrode 6 and an electrode 7, as shown in reflective display 9a and transparency display 10a is explained below.

[0221] In this case, outgoing radiation is carried out from a polarizing plate 14, with bearing of the linearly polarized light which passed again the liquid crystal layer 1 after it reaches the reflective film 8, without a polarization condition changing, as for incident light since an ambient light turns into the linearly polarized light with a polarizing plate 14 in reflective display 9a and the liquid crystal layer 1 does not have a retardation to that linearly polarized light and a travelling direction is further reversed, and intersected perpendicularly with absorption shaft bearing of a polarizing plate 14 maintained.

[0222] Moreover, it passes through a polarizing plate 14 also in transparency display 10a, incident light's turning into the linearly polarized light, and maintaining bearing of the linearly polarized light in general with a polarizing plate 15, like reflective display 9a.

[0223] When using the polarization conversion operation by the above optical anisotropies for a display, liquid crystal is carrying out parallel orientation of the amount of this polarization conversion operation, and when the electrical potential difference is not impressed to the liquid crystal layer 1, it is determined by the product (deltan-d) of the twist angle of the orientation of the liquid crystal layer 1, and a liquid crystal thickness (d) and the refractive-index difference (deltan) of a liquid crystal constituent. For this reason, like this invention, in the liquid crystal display which uses the transmitted light and the reflected light for a display, it is effective that the transparency display 10 has liquid crystal thickness thicker than the reflective display 9 in order to reconcile the lightness and the contrast ratio of a display by both the reflective display 9 and the transparency display 10. In addition, twist angles may differ respectively by the reflective display 9 and the transparency display 10.

[0224] Moreover, when the above-mentioned liquid crystal display is equipped with the phase contrast compensating plate 16-17, to the light of two or more wavelength of a light region, sufficient lightness and a sufficient contrast ratio can be secured, consequently a still better display can be realized.

[0225] Moreover, even if the liquid crystal constituent and orientation of the liquid crystal layer 1 are the same as that of the above-mentioned explanation, it is possible to reverse change of the above-mentioned display according to an operation of the phase contrast compensating plate 16-17. If it is got blocked, for example, a quarter-wave length plate is used as a phase contrast compensating plate 16-17, in reflective display 9b An ambient light becomes the liquid crystal layer 1 with the phase contrast compensating plate 16 at the circular polarization of light in the case of incidence, and further according to the polarization conversion operation by the optical anisotropy of the liquid crystal layer 1 When reaching the reflective film 8, after it becomes the linearly polarized light and a travelling direction is reversed with the reflective film 8, Since it is again changed into the transparency component of a polarizing plate 14 and outgoing radiation is carried out from a polarizing plate 14, it becomes clear display, and as shown in reflective display 9a, when liquid crystal orientation changes, since an ambient light reaches the reflective film 8 with the circular polarization of light, it becomes a dark display.

[0226] Moreover, although the above-mentioned explanation explained the case where a display changed from a dark display to clear display, with the increment in the potential difference of an electrode 6 and

an electrode 7, change of this display can be reversed by making negative the dielectric constant anisotropy of the liquid crystal constituent used for the liquid crystal layer 1, and making the initial orientation condition of liquid crystal into vertical orientation, as it is not limited to this and mentioned above.
[0227] Here, in setting the initial orientation condition of liquid crystal as vertical orientation, it equips the polarization conversion operation of initial orientation with the technical feature of not being greatly influenced by the production precision of liquid crystal thickness. Therefore, it can become the high means of mass production nature to assign an initial orientation condition to a black display so that the black display which influences display grace greatly may be stabilized, in order to employ this description efficiently. In order to realize especially this, after the polarization conversion operation of the liquid crystal layer 1 which carried out orientation vertically has disappeared mostly, it is necessary to give an indication black, and a good circular polarization of light-ized operation is required for the phase contrast compensating plate 16. That is, it is important to have a configuration which serves as the circular polarization of light on the largest possible wavelength as a phase contrast compensating plate 16.
[0228] Moreover, the transparency display 10 serves as a dark display in the liquid crystal orientation shown in clear display and transparency display 10a in the liquid crystal orientation shown in transparency display 10b, when being arranged so that it may have absorption shaft bearing where it is arranged in so that it may have lagging-axis bearing where the phase contrast compensating plate 17 and the phase contrast compensating plate 16 intersect perpendicularly, and a polarizing plate 14 and a polarizing plate 15 intersect perpendicularly mutually.
[0229] Even if the orientation of the liquid crystal layer 1 is which [of parallel orientation and vertical orientation] case, when it changes liquid crystal thickness by the reflective display 9 and the transparency display 10, in the liquid crystal display concerning this invention by the reflective display 9 and the transparency display 10 In order to reconcile lightness and a contrast ratio It displays, when the light which carried out incidence through the liquid crystal layer 1 from the screen side carries out outgoing radiation to a screen side through the liquid crystal layer 1 in the reflective display 9 again, as mentioned above. In the transparency display 10 When the light which carried out incidence from the tooth-back side (back light 13 side) passes the liquid crystal layer 1 only at once, and carries out outgoing radiation to a screen side and it displays It is effective that the liquid crystal thickness in the transparency display 10 is set up more thickly than the liquid crystal thickness in the reflective display 9, and satisfies the above-mentioned conditions as the result.
[0230] Although a concrete example and the example of a comparison are given and explained with reference to drawing 4 - drawing 8 about the liquid crystal display which uses change of the polarization condition by polarization conversion operation of the liquid crystal layer 1 for a display among the liquid crystal displays concerning the gestalt of this operation hereafter using a polarizing plate 14-15, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0231] [An example 2 - an example 4]
In the example 2 - the example 4, the liquid crystal cell for liquid crystal impregnation which has the liquid crystal thickness (d) whose transparency display 10 is 7.5 micrometers, and whose reflective display 9 is 4.5 micrometers was produced by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach. That is, also in the example 2 - the example 4, by sensitization resin's not remaining in the transparency display 10, but carrying out pattern formation of the insulator layer 11 so that it may be formed in the thickness this whose sensitization resin is 3 micrometers in the reflective display 9, in the transparency display 10, liquid crystal thickness set up rather than the reflective display 9 so that it might become thick. However, in the example 2 - the example 4, as shown in drawing 4, the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that

an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0232] Furthermore, in the example 2 – the example 4, the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal impregnation is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a forward dielectric constant anisotropy by the vacuum pouring-in method.
[0233] And the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the liquid crystal cell obtained by doing in this way, and the liquid crystal display was produced. At this time, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 17 from examples 2-4, the phase contrast compensating plate of one sheet constituted the phase contrast compensating plate 16 from the example 3, and the phase contrast compensating plate of two sheets constituted it from the example 2-4. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0234] Moreover, in the example 2, liquid crystal orientation was made into homogeneous orientation, and used NB (Nor Marie Black) mode for the display. In the example 3, liquid crystal orientation was made into homogeneous orientation, and used NW (Nor Marie White) mode for the display. And in the example 4, what mixed these (NB mode is used for a reflective display and NW mode is used for a transparency display) was used.
[0235] However, in the above-mentioned example 2 – the example 4, when not impressing an electrical potential difference, while using the orientation film of a parallel stacking tendency for the orientation film 2-3, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed, so that liquid crystal might carry out orientation to parallel at the screen.
[0236] As it is indicated in drawing 5 as a rubbing crossed axes angle, it sets to the liquid crystal cell for liquid crystal impregnation here. It is based on the rubbing bearing X which is orientation processing bearing of the orientation film 2 (namely, orientation film 2 by the side of a substrate 4) in the electrode substrate which is an observer side substrate among the electrode substrates of the couple which pinches the liquid crystal layer 1. It is defined as the include angle which measured the rubbing bearing Y which is orientation processing bearing of the orientation film 3 (namely, orientation film 3 by the side of a substrate 5) in the electrode substrate of another side to the circumference of an anti-clock.
[0237] The orientation condition of the liquid crystal molecule in the liquid crystal layer 1 currently pinched with the orientation film 2-3 by which orientation processing was carried out is determined by the stacking tendency of the orientation film 2-3, the addition of the chiral additive which gives the twist of a proper to liquid crystal, and the rubbing crossed axes angle when electric field, a field, etc. do not exist.
[0238] When a rubbing crossed axes angle is 180 degrees, orientation of the liquid crystal constituent with which the chiral additive is not mixed is carried out without twisting. Moreover, orientation of the liquid crystal layer 1 is carried out without twisting, and when a chiral additive carries out induction of the twist of a left twist to liquid crystal, if a certain constant rate is exceeded, twist orientation (180-degree left twist orientation) of it will be carried out to counterclockwise twining 180 degrees, until the addition of a chiral additive reaches a certain constant rate. And if the addition of the above-mentioned chiral additive is increased further, 180 twists of only an integral multiple will be realized according to the increment in a chiral additive.
[0239] Therefore, orientation bearing of the liquid crystal on the orientation film 3 realized with the rubbing crossed axes angle (180 degrees) mentioned above in the gestalt of this operation When you increase the quantity of a chiral additive x times in making into x times rubbing bearing X of the orientation film 2 arranged on the electrode substrate of the liquid crystal layer 1 upside and not adding

a chiral additive, and you are twisting on the left 180 degrees between up-and-down electrode substrates, suppose that it is expressed as whenever (180+x).
[0240] In addition, it is the so-called parallel orientation film with which the orientation film 2-3 carries out orientation of the liquid crystal to parallel to an orientation film surface in such orientation processing. When the dielectric constant anisotropy in which the chiral additive is not mixed uses a forward pneumatic liquid crystal When not impressing an electrical potential difference, a liquid crystal molecule is almost parallel to the electrode substrate of the upper and lower sides whose liquid crystal layer 1 is pinched, and takes an orientation (namely, homogeneous orientation) condition without a twist, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.
[0241] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in each liquid crystal display obtained in the example 2 - the example 4, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 1 using the criteria of common bearing in each example.
[0242] In addition, the optical arrangement shown in a table 1 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0243] Moreover, although orientation bearing (orientation bearing of a liquid crystal molecule major axis) of the liquid crystal layer 1 whole at the time of no electrical-potential-difference impressing has been indicated since the liquid crystal layer 1 has taken the orientation which is not twisted, this orientation bearing is bearing of the orientation processing performed to the orientation film 2 by the side of a substrate 4.
[0244] In addition, each bearing expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation (namely, product of the refractive-index difference within the field of a phase contrast compensating plate and thickness) of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0245]
[A table 1]

			実施例2	実施例3	実施例4
偏光板14		透過軸方位 (度)	0	0	0
位相差補償板16	位相差補償板	遅相軸方位 (度)	15	15	15
		リタデーション (nm)	270	270	270
	位相差補償板	遅相軸方位 (度)	165	なし	165
		リタデーション (nm)	135	なし	135
液晶層1		配向方位 (度)	75	75	75
位相差補償板17	位相差補償板	遅相軸方位 (度)	165	165	165
		リタデーション (nm)	70	220	90
	位相差補償板	遅相軸方位 (度)	135	135	105
		リタデーション (nm)	270	270	270
偏光板15		透過軸方位 (度)	60	60	90

[0246] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 2, the example 3, and the example 4 is respectively shown in drawing 6, drawing 7, and drawing 8. In addition, each of these display properties is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage in each above-mentioned drawing, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, make into 100% of permeability the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.
[0247] In drawing 6, a curve 211 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 2, and a curve 212 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 2.
[0248] As shown in drawing 6, in the example 2, both a reflection factor and permeability are rising with lifting of applied voltage in the section whose applied voltage is 1V-2V. Moreover, both the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V, and the permeability of the transparency display 10 were 40%.
[0249] Moreover, in drawing 7, a curve 221 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3, and a curve 222 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3.
[0250] As shown in drawing 7, in the example 3, both a reflection factor and permeability are decreasing with lifting of applied voltage in the section whose applied voltage is 1V-2V. Moreover, both the reflection factor of the reflective display 9 in case applied voltage is 1V, and the permeability of the transparency display 10 were 40%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 2V was 2% 3%.
[0251] Moreover, in drawing 8, a curve 231 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4, and a curve 232 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4.
[0252] As shown in drawing 8, while a reflection factor rises with lifting of applied voltage, in the example 4, permeability is decreasing in the section whose applied voltage is 1V-2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 40% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V was 2% 40%.
[0253] As mentioned above, all, a reflection factor changes to a permeability list with the change of applied voltage to this liquid crystal display, and both the reflective display and the transparency display were possible for the liquid crystal display obtained in the above-mentioned example 2 - the example 4.
[0254] Furthermore, when visual observation is carried out, it sets in an example 2 and the example 3. By impressing the same electrical potential difference to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 Since it displayed with the electrode 6 and the electrode 7 by keeping the same the electrical potential difference applied to the liquid crystal layer 1 by the

reflective display 9 and the transparency display 10, change of light and darkness is the same at the reflective display 9 and the transparency display 10, and it checked that reversal of the light and darkness of a display did not arise. Moreover, even if it is in the middle of observation and changed the reinforcement of an ambient light in the case of this display, change of the content of a display was not seen. That is, when the reflective display 9 was a dark display, the transparency display 10 also became a dark display, and when the reflective display 9 was clear display, the transparency display 10 also became clear display. For this reason, reversal of a display was not produced when it drove at the reflective display 9 and the transparency display 10 using the same electrode 7 like a publication to said drawing 1.

[0255] On the other hand, in the example 4, when an electrical potential difference was impressed like an example 2 and an example 3 (i.e., when the electrical potential difference of 1V is impressed), the transparency display 10 became clear display and the reflective display 9 became a dark display. Moreover, when the electrical potential difference of 2V was impressed, the transparency display 10 became a dark display and the reflective display 9 became clear display. For this reason, the light and darkness of a display were reversed by the transparency display 10 and the reflective display 9. When it displayed in the weak environment of an ambient light, and the transparency display 10 was mainly being observed for this reversal, the ambient light was strengthened and the reflective display was performed, the light and darkness of a display were reversed and difficulty was produced in the check of the content of a display. As shown in an example 4, when the same electrical potential difference was impressed from this to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 and it was the mixed mode of NB and NW, reversal of a display was large and the thing of the reflective display 9 and the transparency display 10 for which visibility is worsened was checked.

[0256] So that the transparency display 10 may also serve as clear display and the transparency display 10 may also serve as a dark display simultaneous when the reflective display 9 is a dark display simultaneous when the reflective display 9 is clear display in an example 4 on the other hand A different electrical potential difference to the electrode 7 in the reflective display 9 and the electrode 7 in the transparency display 10 is impressed. that is, when impressing the electrical potential difference (1V) this reflective display 9 indicates a dark display to be to the reflective display 9 with an electrode 6-7 (orientation device) When impressing the electrical potential difference (2V) from which this transparency display 10 serves as a dark display to the transparency display 10 and impressing the electrical potential difference (2V) from which this reflective display 9 serves as clear display at the reflective display 9 By impressing the electrical potential difference (1V) from which this transparency display 10 serves as clear display to the transparency display 10, reversal of the light and darkness of a display was solved and the same good display condition as an example 2 and an example 3 was acquired.

[0257] The above thing shows that each liquid crystal display of the above-mentioned example 2 - an example 4 can realize the display which could make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10, and was excellent in visibility while each was [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9. Moreover, it turns out that each of each liquid crystal displays of the above-mentioned example 2 - an example 4 can raise display grace further, and can perform a good display from the contrast ratio in the transparency display 10 exceeding the contrast ratio in the reflective display 9.

[0258] Next, although a concrete example and the example of a comparison are given and explained with reference to drawing 9 and drawing 10 about the liquid crystal display which uses a polarization conversion operation of the liquid crystal layer 1 by the twist orientation of the liquid crystal layer 1 for a display among the liquid crystal displays concerning the gestalt of this operation, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0259] [Example 5]

In this example, the liquid crystal cell for liquid crystal impregnation which has the liquid crystal thickness whose transparency display 10 is 7.5 micrometers, and whose reflective display 9 is 4.5 micrometers was produced by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach. That is, also in this example, by sensitization resin's not remaining in the transparency display 10, but carrying out pattern formation of the insulator layer 11 so that it may be formed in the thickness this whose sensitization resin is 3 micrometers in the reflective display 9, in the transparency display 10, liquid crystal thickness set up rather than the reflective display 9 so that it might become thick.
[0260] However, in this example, like examples 2-4, as shown in drawing 4, the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0261] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0262] At this example, it is the twist orientation (the liquid crystal display was produced so that the twist angle (twist angle) of the orientation of liquid crystal might become 70 degrees.) of the liquid crystal layer 1. Specifically, orientation processing was performed using the orientation film of a parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0263] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 2 using the criteria of common bearing.
[0264] [Example 6]
This example as well as an example 5 produced the liquid crystal cell for liquid crystal impregnation which has the liquid crystal thickness (d) whose transparency display 10 is 7.5 micrometers, and whose reflective display 9 is 4.5 micrometers by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach. Moreover, as shown in drawing 4, the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0265] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the

outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, in this example, the phase contrast compensating plate of one sheet was respectively used for the phase contrast compensating plate 16 and the phase contrast compensating plate 17. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0266] In this example, the liquid crystal display was produced so that the twist orientation (twist angle of the orientation of liquid crystal (twist angle)) of the liquid crystal layer 1 might become 90 degrees. Specifically, orientation processing was performed using the orientation film of a parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 270 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 90 degrees. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0267] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 2 using the criteria of common bearing.
[0268] In addition, the optical arrangement shown in a table 2 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0269] Moreover, orientation bearing (orientation bearing of a liquid crystal molecule major axis) of the liquid crystal layer 1 is equal to bearing of the rubbing processing performed to the orientation film 2 by the side of a substrate 4 in a substrate 4 side, and equal to bearing of the rubbing processing performed to the orientation film 3 by the side of a substrate 5 in a substrate 5 side. However, when orientation bearing of the liquid crystal which touches the orientation film 2 is pursued to the orientation film 3 side, 90 left twist orientation is carried out. Thus, when liquid crystal orientation is pursued and rubbing processing bearing to the orientation film 2 is considered to be orientation bearing by the side of a substrate 4 (for it to be hereafter written as substrate 4 orientation bearing), rubbing bearing of the orientation film 3 turns into bearing which reversed bearing which pursued the orientation of liquid crystal according to the twist 180 degrees. Hereafter, orientation bearing by the side of a substrate 5 (it is hereafter written as substrate 5 orientation bearing) is defined as liquid crystal orientation on the substrate 5 which pursued the orientation of liquid crystal according to the twist from substrate 4 orientation bearing.
[0270] In addition, each bearing in a table 2 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0271]
[A table 2]

			実施例５	実施例６
偏光板１４		透過軸方位　（度）	０	０
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１８	１２
		リタデーション（nm）	２７０	１３５
	位相差補償板	遅相軸方位　（度）	１２６	なし
		リタデーション（nm）	１３５	なし
液晶層１		基板４配向方位　（度）	１６	－１１
		基板５配向方位　（度）	８６	７９
位相差補償板１７	位相差補償板	遅相軸方位　（度）	－４	１３５
		リタデーション（nm）	２６０	２６０
偏光板１５		透過軸方位　（度）	１５２	９０

[0272] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 5 and the example 6 is respectively shown in drawing 9 and drawing 10. In addition, each of these display properties is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage in each above-mentioned drawing, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, make into 100% of permeability the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.
[0273] In drawing 9, a curve 241 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5, and a curve 242 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5.
[0274] As shown in drawing 9, in the example 5, both a reflection factor and permeability are rising [applied voltage] with lifting of applied voltage in the section beyond 1.2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 4V was 40% 41%.
[0275] Moreover, in drawing 10, a curve 251 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 6, and a curve 252 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 6.
[0276] As shown in drawing 10, both a reflection factor and permeability are rising [applied voltage] with lifting of applied voltage in the example 6 as well as an example 5 in the section beyond 1.2V. Moreover, in the example 6, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 4V was 37% 35%.
[0277] As mentioned above, all, a reflection factor changes to a permeability list with the change of

applied voltage to this liquid crystal display, and both the reflective display and the transparency display were possible for the liquid crystal display obtained in the above-mentioned example 5 and the example 6.
[0278] Furthermore, when visual observation is carried out, it sets in an example 5 and the example 6. By impressing the same electrical potential difference to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 When displaying with the electrode 6 and the electrode 7 by keeping the same the electrical potential difference applied to the liquid crystal layer 1 by the reflective display 9 and the transparency display 10, change of light and darkness is the same at the reflective display 9 and the transparency display 10, and it checked that reversal of the light and darkness of a display did not arise. Moreover, even if it is in the middle of observation and changed the reinforcement of an ambient light in the case of this display, change of the content of a display was not seen. That is, when the reflective display 9 was a dark display, the transparency display 10 also became a dark display, and when the reflective display 9 was clear display, the transparency display 10 also became clear display. For this reason, in the above-mentioned example 5 and the example 6, when it drove at the reflective display 9 and the transparency display 10 using the same electrode 7 like a publication to said drawing 1, reversal of a display was not produced.
[0279] Therefore, all, each liquid crystal display of the above-mentioned example 5 and an example 6 can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while it is [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9, and it can realize the display excellent in visibility. Moreover, from the contrast ratio in the transparency display 10 exceeding the contrast ratio in the reflective display 9, each of each liquid crystal displays of the above-mentioned example 5 and an example 6 can raise display grace further, and can realize a good display.
[0280] Moreover, an example 6 has little number of sheets of the phase contrast compensating plate used as compared with an example 5, and the liquid crystal display which is excellent in visibility and uses for a display both the reflected lights and transmitted lights in which a high resolution color display (color display) is possible can be offered more cheaply.
[0281] With the gestalt of the above operation, by changing liquid crystal thickness by the reflective display and the transparency display explained the liquid crystal display which performs a good transparency display in a good reflective display list. The following explanation explains the liquid crystal display which sets up and performs a good transparency display in a good reflective display list so that the liquid crystal thickness in a reflective display and the liquid crystal thickness in a transparency display may become equal.
[0282] [The gestalt 3 of operation]
With the gestalt of this operation, when the liquid crystal thickness in a reflective display and the liquid crystal thickness in a transparency display are equal, the liquid crystal display which realizes a good transparency display is explained to a good reflective display list by changing the electrical potential difference which carries out a seal of approval by the reflective display and the transparency display, and changing liquid crystal orientation by the reflective display and the transparency display.
[0283] With the gestalt of this operation, the polarizing plate 14-15 of a publication is used for the gestalt 2 of said operation, the case where it sets up in the liquid crystal display which uses the retardation of the liquid crystal layer 1 for a display so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10 is mentioned as an example, and such a liquid crystal display is explained using a concrete example and the example of a comparison with reference to drawing 4 and drawing 11 - drawing 16. However, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0284] In addition, the same number is given to the component which has the function as the gestalt 1 of said operation, and the gestalt 2 of operation of explanation same for convenience, and the explanation is omitted. Moreover, since it is the same as that of the gestalt 2 of said operation except

being set up about the concrete whole configuration of the liquid crystal display concerning the gestalt of this operation so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10, the explanation is omitted here.

[0285] What is necessary is just to form an electrode 7 directly on a substrate 5, without forming the insulator layer 11 formed on said substrate 5, in order to set up so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10 as shown in the gestalt of this operation.

[0286] [Example 7]

As the insulator layer 11 which consists of sensitization resin which has insulation is not formed on a substrate 5 in an example 1 in this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 4.5-micrometer liquid crystal thickness (d).

[0287] And the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal impregnation is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a forward dielectric constant anisotropy by the vacuum pouring-in method.

[0288] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).

[0289] In this example, while using the liquid crystal layer in which liquid crystal carries out orientation to parallel (it is parallel to the screen) and which has not carried out twist orientation to the liquid crystal layer 1 to the substrate 4-5, the birefringence mode in which the retardation of the liquid crystal layer 1 was used for a display was used as a liquid crystal display method.

[0290] Moreover, the retardation suitable for a reflective display was used for the transparency display 10 in this example. Here, although the reflective display 9 is set up like the reflective display 9 of the example 2 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the reflective display 9, and it is set up by the transparency display 10, and differ in the example 2. For this reason, in this example, in an example 2, again, the optical design was performed and optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that the dark display of the transparency display 10 might be good.

[0291] Moreover, in this example, while using the orientation film of a parallel stacking tendency for the orientation film 2-3 like said example 2 so that liquid crystal might carry out orientation to parallel at the screen when not impressing an electrical potential difference, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed.

[0292] In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.

[0293] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 3 using the criteria of common bearing.
[0294] [The example 3 of a comparison]
Here, the example of a comparison of the above-mentioned example 7 is shown. In this example 3 of a comparison, while the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 in the liquid crystal display shown in an example 7, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having set optical arrangement of the phase contrast compensating plate 16-17 as polarizing plate 14 and 15 lists so that the clear display of the transparency display 10 might become good. Pasting bearing of the above-mentioned phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0295] Moreover, also in this example of a comparison, while using the orientation film of a parallel stacking tendency for the orientation film 2-3 like said example 7 so that liquid crystal might carry out orientation to parallel at the screen when not impressing an electrical potential difference, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed.
[0296] In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.
[0297] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of a comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 3 using the criteria of common bearing.
[0298] [Example 8]
In this example, liquid crystal thickness [in / on the liquid crystal display shown in an example 7 and / the reflective display 9] (d) and the liquid crystal thickness (d) in the transparency display 10 are both 7.5 micrometers. The retardation suitable for a transparency display was used for the reflective display 9, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having set optical arrangement of the phase contrast compensating plate 16-17 as polarizing plate 14 and 15 lists so that a reflective display might be good.
[0299] As the insulator layer 11 which consists of sensitization resin which has insulation is not more specifically formed on a substrate 5 in an example 1 by this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 7.5-micrometer liquid crystal thickness (d).
[0300] And the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal impregnation is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a forward dielectric constant anisotropy by the vacuum pouring-in method.
[0301] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the

outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0302] In this example, while using the liquid crystal layer in which liquid crystal carries out orientation to parallel (it is parallel to the screen) and which has not carried out twist orientation to the liquid crystal layer 1 to the substrate 4-5, the birefringence mode in which the retardation of the liquid crystal layer 1 was used for a display was used as a liquid crystal display method.
[0303] Moreover, the retardation suitable for a transparency display was used for the reflective display 9 in this example. Here, although the transparency display 10 is set up like the transparency display 10 of the example 2 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the transparency display 10, and it is set up by the reflective display 9, and differ in the example 2. For this reason, in this example, in an example 2, again, the optical design was performed and optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that a reflective display might be good.
[0304] Moreover, in this example, while using the orientation film of a parallel stacking tendency for the orientation film 2-3 like said example 2 so that liquid crystal might carry out orientation to parallel at the screen when not impressing an electrical potential difference, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed.
[0305] In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of an electrical potential difference according to an electrical potential difference.
[0306] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 3 using the criteria of common bearing.
[0307] In addition, the optical arrangement shown in a table 3 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0308] Moreover, although orientation bearing (orientation bearing of a liquid crystal molecule major axis) of the liquid crystal layer 1 whole at the time of no electrical-potential-difference impressing has been indicated since the liquid crystal layer 1 has taken the orientation which is not twisted, this orientation bearing is bearing of the rubbing processing performed to the orientation film 2 by the side of a substrate 4.
[0309] In addition, each bearing expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0310]
[A table 3]

			実施例7	比較例3	実施例8
偏光板14		透過軸方位　(度)	0	0	0
位相差補償板16	位相差補償板	遅相軸方位　(度)	15	15	15
		リタデーション (nm)	270	270	270
	位相差補償板	遅相軸方位　(度)	165	165	165
		リタデーション (nm)	135	135	135
液晶層1		配向方位　(度)	75	75	75
位相差補償板17	位相差補償板	遅相軸方位　(度)	75	105	165
		リタデーション (nm)	135	270	70
	位相差補償板	遅相軸方位　(度)	135	なし	135
		リタデーション (nm)	270	なし	270
偏光板15		透過軸方位　(度)	60	0	60

[0311] [The example 4 of a comparison]
In the liquid crystal display shown in an example 7 in this example of a comparison in the liquid crystal layer 1 Liquid crystal carries out orientation to parallel (it is parallel to the screen) to a substrate 4-5. And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.
[0312] As the insulator layer 11 which consists of sensitization resin which has insulation is not more specifically formed on a substrate 5 in an example 1 in this example of a comparison and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 4.5-micrometer liquid crystal thickness (d).
[0313] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example of a comparison. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).
[0314] Furthermore, in this example of a comparison, orientation processing was performed by performing rubbing processing using the orientation film of a parallel stacking tendency, so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when a refractive-index difference (deltan) introduced the liquid crystal constituent which

has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. In addition, the above-mentioned chiral additive is adjusting the addition so that the above-mentioned twist angle may be acquired. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0315] Moreover, in this example of a comparison, the refractive-index difference (deltan) of the liquid crystal constituent suitable for a reflective display and the product (deltan-d) with liquid crystal thickness (d) were used for the transparency display 10. Here, although the reflective display 9 is set up like the reflective display 9 of the example 5 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the reflective display 9, and it is set up by the transparency display 10, and differ in the example 5. For this reason, in this example of a comparison, in an example 5, again, the optical design was performed and optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example of a comparison, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that the dark display of the transparency display 10 might be good.
[0316] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of a comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 4 using the criteria of common bearing.
[0317] [The example 5 of a comparison]
In this example of a comparison, the liquid crystal display shown in the example 4 of a comparison and the liquid crystal display designed similarly were produced in the liquid crystal display shown in the example 4 of a comparison except having set optical arrangement of the phase contrast compensating plate 16-17 as polarizing plate 14 and 15 lists so that the clear display of the transparency display 10 might become good. Namely, in this example of a comparison, in the liquid crystal display shown in an example 7, optical arrangement of the phase contrast compensating plate 16-17 is set as polarizing plate 14 and 15 lists so that the clear display of the transparency display 10 may become good. And liquid crystal carries out orientation to the liquid crystal layer 1 to a substrate 4-5 at parallel (it is parallel to the screen). And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.
[0318] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of a comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 4 using the criteria of common bearing.
[0319] [Example 9]
While the phase contrast compensating plate of two sheets constitutes the phase contrast compensating plate 16 from this example in the liquid crystal display shown in an example 8 The phase contrast compensating plate 17 is constituted from a phase contrast compensating plate of one sheet. In the liquid crystal layer 1 liquid crystal The liquid crystal layer which carried out orientation to parallel (it is parallel to the screen) and which carried out twist orientation to them 70 degrees to the substrate 4-5 is used. Except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display, the liquid crystal display shown in an example 8 and the liquid crystal display designed similarly were produced.
[0320] As the insulator layer 11 which consists of sensitization resin which has insulation is not more

specifically formed on a substrate 5 in an example 1 by this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 7.5-micrometer liquid crystal thickness (d).

[0321] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. Pasting bearing of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation bearing).

[0322] And in this example, the liquid crystal display was produced so that the twist orientation (twist angle of the orientation of liquid crystal (twist angle)) of the liquid crystal layer 1 might become 70 degrees. Specifically, orientation processing was performed using the orientation film of a parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing an electrical potential difference to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal impregnation, when the refractive-index difference (deltan) of a liquid crystal constituent introduced the liquid crystal constituent which has the forward dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. According to such orientation processing and an operation of the chiral additive added to the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. In addition, the above-mentioned chiral additive is adjusting the addition so that the above-mentioned twist angle may be acquired. Thus, according to an electrical potential difference, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of an electrical potential difference from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.

[0323] Moreover, in this example, the refractive-index difference (deltan) of the liquid crystal constituent suitable for a transparency display and the product (deltan-d) of liquid crystal thickness (d) were used for the reflective display 9. Here, although the transparency display 10 is set up like the transparency display 10 of the example 5 in the gestalt 2 of said operation, the liquid crystal thickness is equal to the transparency display 10, and it is set up by the reflective display 9, and differ in the example 5. For this reason, in this example, in an example 5, again, the optical design was performed and optical arrangement of the phase contrast compensating plate 16-17 is determined as the optical arrangement list of a polarizing plate 14-15. In this example, optical arrangement of the phase contrast compensating plate 16-17 was set as these polarizing plate 14 and 15 lists so that a reflective display might be good.

[0324] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 4 using the criteria of common bearing.

[0325] In addition, the optical arrangement shown in a table 4 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast

compensating plates, the Gentlemen phase reference compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each bearing in a table 4 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.

[0326]

[A table 4]

			比較例4	比較例5	実施例9
偏光板14		透過軸方位 (度)	0	0	0
位相差補償板16	位相差補償板	遅相軸方位 (度)	18	18	18
		リタデーション (nm)	270	270	127
	位相差補償板	遅相軸方位 (度)	126	126	126
		リタデーション (nm)	135	135	135
液晶層1		基板4配向方位 (度)	16	16	16
		基板5配向方位 (度)	86	86	86
位相差補償板17	位相差補償板	遅相軸方位 (度)	36	36	−4
		リタデーション (nm)	135	135	260
	位相差補償板	遅相軸方位 (度)	96	108	なし
		リタデーション (nm)	270	270	なし
偏光板15		透過軸方位 (度)	21	0	152

[0327] As mentioned above, in the liquid crystal display concerning the example 7 and the examples 3-5 of a comparison which have 4.5-micrometer liquid crystal thickness (d), liquid crystal thickness is set up so that it may be suitable for a reflective display. For this reason, in the above-mentioned example 7 and the examples 3-5 of a comparison, optical arrangement with the polarizing plate 14 and the phase contrast compensating plate 16 only related to a reflective display is set up so that it may be suitable for a reflective display. On the other hand, the transparency display 10 is set as the liquid crystal thickness in which the liquid crystal thickness differs from the liquid crystal thickness of the transparency display 10 of the liquid crystal display in each example of the gestalt 2 of said operation. For this reason, in the above-mentioned example 7 and the examples 3-5 of a comparison, it combined with the optical property of the transparency display 10 of each liquid crystal display, and optical arrangement of the phase contrast compensating plate 17 and a polarizing plate 15 was set up. That is, in the example 7 and the example 4 of a comparison, the liquid crystal display which can realize a good dark display was produced, and the liquid crystal display which can realize good clear display was produced in the example 3 of a comparison, and the example 5 of a comparison.

[0328] On the other hand, in the liquid crystal display concerning the example 8 and example 9 which have 7.5-micrometer liquid crystal thickness (d), liquid crystal thickness is set up so that it may be suitable for a transparency display. For this reason, in the above-mentioned example 8 and the example 9, optical arrangement of the polarizing plate 14 related to a transparency display, the phase contrast

compensating plate 16, the phase contrast compensating plate 17, and a polarizing plate 15 is set up so that it may be suitable for a transparency display. Therefore, a display property is determined by optical arrangement of the polarizing plate 14 with which the reflective display 9 was set up to compensate for the transparency display, and the phase contrast compensating plate 16 in the above-mentioned example 8 and the example 9.
[0329] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 7, the example 3 of a comparison, the example 8, the example 4 of a comparison, the example 5 of a comparison, and the example 9 is respectively shown in drawing 11, drawing 12, drawing 13, drawing 14, and drawing 15. In addition, each measures these display properties using a microscope like an example 1, an axis of abscissa shows the actual value of applied voltage in each above-mentioned drawing, and an axis of ordinate shows lightness (a reflection factor or permeability). Moreover, make into 100% of permeability the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.
[0330] In drawing 11, a curve 261 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 7, and a curve 262 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 7.
[0331] In the example 7, as shown in drawing 11, while permeability rises with lifting of applied voltage, a reflection factor rises with lifting of applied voltage in the section whose applied voltage is 1V-2V, and it is decreasing with lifting of applied voltage in the section whose applied voltage is 1V-3V after it. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 40% and the transparency display 10 is 18% and the applied voltage of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 3% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V is 3V was 33% 28%.
[0332] Moreover, in drawing 12, a curve 271 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3 of a comparison, and a curve 272 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3 of a comparison.
[0333] As shown in drawing 12, in the example 3 of a comparison, both a reflection factor and permeability are rising with lifting of applied voltage in the section whose applied voltage is 1V-2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 18% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V was 40% 40%.
[0334] In drawing 13, a curve 281 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 8, and a curve 282 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 8.
[0335] As shown in drawing 13, in the section whose applied voltage is 1V-2V in the example 8 While permeability rises with lifting of applied voltage, a reflection factor After going up with lifting of applied voltage in the section whose applied voltage is 0.7V-1.2V, applied voltage once decreases with lifting of applied voltage in the section which are 1.2V-1.7V, and it is going up with lifting of applied voltage again

after that in the section whose applied voltage is 1.7V−2.3V. Moreover, the reflection factor of the reflective display 9 in case 40% and the applied voltage of the reflection factor of the reflective display 9 in case as for the permeability of 24% and the transparency display 10 the reflection factor of the reflective display 9 in case applied voltage is 1V is 3% and its applied voltage is 1.2V are 1.7V was 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 2V was 39% 27%.

[0336] In drawing 14, a curve 291 shows the electrical−potential−difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4 of a comparison, and a curve 292 shows the electrical−potential−difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4 of a comparison.

[0337] As shown in drawing 14, in the example 4 of a comparison, both a reflection factor and permeability are rising with lifting of applied voltage in the section whose applied voltage is 1.2V−3V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 1% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1.2V is 3V was 16% 36%.

[0338] In drawing 15, a curve 311 shows the electrical−potential−difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5 of a comparison, and a curve 312 shows the electrical−potential−difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5 of a comparison.

[0339] As shown in drawing 15, in the example 5 of a comparison, both a reflection factor and permeability are rising with lifting of applied voltage in the section whose applied voltage is 1.2V−3V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 21% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1.2V is 3V was 35% 39%.

[0340] In drawing 16, a curve 321 shows the electrical−potential−difference dependency of the reflection factor of the reflective display 9 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 9, and a curve 322 shows the electrical−potential−difference dependency of the permeability of the transparency display 10 to the electrical potential difference between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 9.

[0341] In the example 9, as shown in drawing 16, while permeability rises with lifting of applied voltage, a reflection factor once decreases with lifting of applied voltage in the section whose applied voltage is 0.9V−1.7V, and is rising with lifting of applied voltage after it in the section whose applied voltage is 1.2V−3V. Moreover, the reflection factor of the reflective display 9 in case the permeability of 7% and the transparency display 10 is 32% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1.2V is 1.7V was 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 3V was 36% 37%.

[0342] In the liquid crystal display which uses change of the polarization condition by polarization conversion operation of the retardation of the liquid crystal layer 1, the rotatory polarization, etc. for a display using a polarizing plate 14−15 so that clearly from the above example and example of a comparison When the liquid crystal thickness of the liquid crystal layer 1 is made in agreement by the reflective display 9 and the transparency display 10, When the same electrical potential difference is impressed to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10, (when the reflective display 9 and the transparency display 10 are driven on a common electrical potential difference) As shown in an example 7 and the examples 3−5 of a comparison, at the time of

impression of an electrical potential difference fully compatible by the reflective display 9 in the lightness and the contrast ratio of clear display, coexistence with the lightness of the clear display of the transparency display 10 and a contrast ratio is not enough. As shown in an example 8 and an example 9, at the time of impression of an electrical potential difference fully compatible by the transparency display 10 in the lightness and the contrast ratio of clear display, change of the lightness of the reflective display 9 and change of the lightness of the transparency display 10 are not in agreement, and it does not become a good display.

[0343] However, each liquid crystal display obtained in the example 7, the example 8, and the example 9 is what (the reflective display 9 and the transparency display 10 are driven on a different electrical potential difference) a different electrical potential difference to the electrode 7 in the reflective display 9 and the electrode 7 in the transparency display 10 is impressed for, and can be considered as a good display.

[0344] That is, each liquid crystal display of the above-mentioned example 7 – an example 9 By impressing the electrical potential difference from which all differ to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 While it is [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9, the light and darkness of a display can be made in agreement by the reflective display 9 and the transparency display 10, and it turns out that the display excellent in visibility is realizable.

[0345] In the liquid crystal display which uses a polarization conversion operation of the retardation of the liquid crystal layer 1, the rotatory polarization, etc. for a display using a polarizing plate 14–15 as a result of comparing the gestalt of this operation with the gestalt 2 of said operation In order to reconcile the lightness and the contrast ratio of clear display by both the reflective display 9 and the transparency display 10, it turns out that it is effective to set up more greatly than the thickness of the liquid crystal layer 1 in the reflective display 9 the thickness of the liquid crystal layer 1 in the transparency display 10.

[0346] In addition, although the liquid crystal orientation in the condition of not impressing the electrical potential difference showed the parallel thing to the direction of a flat surface of the screen as liquid crystal display mode in each example in the gestalt of this operation, and the gestalt 2 of said operation It cannot be overemphasized by using the liquid crystal ingredient of a different property from the liquid crystal ingredient illustrated in each above-mentioned example, or using the orientation film of a different property from the illustrated orientation film that vertical orientation mode, hybrid orientation mode, etc. can be used.

[0347] Furthermore, even if liquid crystal display mode is which the mode in which the retardation or rotatory polarization of the liquid crystal layer 1 was used, liquid crystal thickness influences an optical property and it cannot be overemphasized that a good optical property realizes all the things for which the one where the liquid crystal thickness in the reflective display 9 is thinner than the liquid crystal thickness in the transparency display 10 is suitable by this invention.

[0348] Moreover, an example 4 and an example 7 – an example 9 are giving the electrical potential difference in which the reflective display 9 and the transparency display 10 change with electrodes 6–7 (orientation device), and it turns out that it becomes possible to display good. In this case, it becomes possible in an example 4 and the example 7 to indicate the transparency display 10 good by fully impressing an electrical potential difference to the transparency display 10. Moreover, a good display is attained when an example 8 and an example 9 all adjust the electrical potential difference of the reflective display 9. Therefore, it turns out that a good display is realizable by producing a liquid crystal cell beforehand so that an electrical potential difference can be changed into the gestalt list of this operation by the reflective display 9 and the transparency display 10 besides the approach of changing liquid crystal thickness by the reflective display 9 and the transparency display 10 according to the gestalt 2 of said operation.

[0349] [The gestalt 4 of operation]
With the gestalt of this operation, by changing orientation processing bearing on the substrate which determines liquid crystal orientation (rubbing bearing), i.e., orientation processing bearing of the orientation film established in each electrode substrate, by the reflective display and the transparency display, and changing liquid crystal orientation by the reflective display and the transparency display explains the liquid crystal display which realizes a good transparency display to a good reflective display list.
[0350] With the gestalt of this operation, in order to carry out orientation of the liquid crystal layer uniformly, the so-called rubbing method is used. In order to change orientation processing bearing of the orientation film established in each electrode substrate by the reflective display and the transparency display with the gestalt of this operation, it is possible to realize at least two kinds of liquid crystal orientation by covering an orientation film front face by a photoresist etc. on the occasion of rubbing processing of the orientation film. According to this approach, it becomes possible to be able to realize simultaneously liquid crystal orientation suitable for a reflective display, and liquid crystal orientation suitable for a transparency display, consequently to realize a good transparency display in a good reflective display list.
[0351] Although the liquid crystal display concerning the gestalt of this operation is hereafter explained more to a detail, the same number is given to the component which has the function as the gestalt 3 of the gestalt 1 of said operation - operation of explanation same for convenience, and the explanation is omitted.
[0352] First, orientation down stream processing of the substrate (electrode substrate 40) used for the liquid crystal display concerning the gestalt of this operation is explained using drawing 17 and drawing 18 (a) - (e).
[0353] First, as shown in drawing 18 (a), an orientation film ingredient is applied to the contact surface with the liquid crystal layer 1 in the substrate 41 (equivalent to the substrate 4 after electrode 6 formation, or the substrate 5 after electrode 7 formation) which constitutes a liquid crystal cell (S1). Prebaking (S2) and curing (S3) are performed, and the orientation film 42 (equivalent to the orientation film 2 or the orientation film 3) is formed in the contact surface with the liquid crystal layer 1 in the above-mentioned substrate 41.
[0354] Subsequently, orientation processing of the electrode substrate 40 which equipped the interface with the liquid crystal layer 1 on the above-mentioned substrate 41 with the orientation film 42 is performed by carrying out rubbing processing of the above-mentioned orientation film 42. Under the present circumstances, with the gestalt of this operation, first, as shown in drawing 18 (b), the screen by the resist 43 for rubbing processing screens is performed so that rubbing processing may be performed selectively. In this case, UV mask exposure (S6), development (S7), and curing (S8) are performed, and rubbing processing is performed to orientation processing field 42a of the above 1st after that so that the resist ingredient for rubbing processing screens may be applied and some above-mentioned orientation film 42 (1st orientation processing field 42a) may be first exposed after (S4) and prebaking (S5) on the above-mentioned orientation film 42 (S9). Subsequently, after washing the electrode substrate 40 after this rubbing processing (S10), as shown in drawing 18 (c), the above-mentioned resist 43 is exfoliated (S11).
[0355] Then, in order to realize different liquid crystal orientation from the liquid crystal orientation in orientation processing field 42a of the above 1st, as shown in drawing 18 (d), the part (1st orientation processing field 42a) by which rubbing was already carried out is protected by the resist 44 for rubbing processing screens, and rubbing processing of an unsettled part is performed. That is, the resist ingredient for rubbing processing screens is applied on the orientation film 42 which exfoliated the resist 43 (S12). So that orientation processing fields other than 1st orientation processing field 42a on the above-mentioned orientation film 42 (2nd orientation processing field 42b) may be exposed after prebaking (S13) UV mask exposure (S14), development (S15), and curing (S16) are performed, and after

that, with orientation processing field 42a of the above 1st, rubbing processing is performed to orientation processing field 42b of the above 2nd so that processing bearing may become separate (S17). Subsequently, after washing the electrode substrate 40 after this rubbing processing (S18), as shown in drawing 18 (e), the above-mentioned resist 44 is exfoliated (S19). Thereby, the orientation film 42 (orientation device) by which orientation processing was carried out was obtained in two kinds of the different bearings.
[0356] Thus, with the gestalt of this operation, orientation processing patterning was carried out [processing] by the resist is performed twice or more. At this time, it is possible to realize at least two kinds of liquid crystal orientation (for example, two or more kinds of parallel orientation where the directions of orientation differ) what (orientation processing of 2 bearing is performed by two orientation processings in the above-mentioned explanation) processing bearing is changed for for every orientation processing. And in this way, by changing orientation processing bearing with one [at least] substrate (electrode substrate), the orientation of the reflective display 9 and the transparency display 10 can be set up independently, and a good display is attained.
[0357] Next, while realizing liquid crystal orientation which changes by the reflective display 9 and the transparency display 10 with approaches mentioned above, the liquid crystal display which used the polarizing plate 14-15 is explained below using a concrete example. However, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0358] [Example 10]
In this example, the liquid crystal display was produced according to the manufacture approach of the liquid crystal display shown in said example 5 of a comparison. As the insulator layer 11 which consists of sensitization resin which has insulation is not specifically formed on a substrate 5 in an example 1 and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that an electrical potential difference might be independently impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside By the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal impregnation which both has 4.5-micrometer liquid crystal thickness (d) and a (cel gap). And the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in this liquid crystal cell. The above-mentioned phase contrast compensating plate 16 and the phase contrast compensating plate 17 consisted of phase contrast compensating plates of every two sheets respectively.
[0359] However, in this example, orientation division was performed on the occasion of rubbing processing of the orientation film 3 by the approach shown in drawing 17 and drawing 18 (a) - drawing 18 (e), and the same approach. That is, in this example, to the orientation film 2 by the side of a substrate 4, rubbing was performed in the same bearing by the reflective display 9 and the transparency display 10, and to the orientation film 3 (orientation device) by the side of a substrate 5, rubbing was performed in the bearing which is different by the reflective display 9 and the transparency display 10 so that liquid crystal orientation bearings might differ by the reflective display 9 and the transparency display 10.
[0360] Moreover, in this example, the liquid crystal display mode using the liquid crystal orientation which is parallel (it is parallel to a substrate 4-5), and was twisted was used for the screen, and the display mode using the liquid crystal orientation which is parallel (it is parallel to a substrate 4-5), and is not twisted to the screen was used for the transparency display 10 at the reflective display 9.
[0361] Moreover, in this example, about 270nm and the twist angle (twist angle) of the orientation of liquid crystal are 70 degrees, and deltan-d of the liquid crystal layer 1 in the reflective display 9 produced the liquid crystal display about 270nm and whose twist angle (twist angle) of the orientation of liquid crystal deltan-d of the liquid crystal layer 1 in the transparency display 10 is 0 times.

Consequently, the liquid crystal display which can perform a good display by both the reflective display 9 and the transparency display 10 was obtained, without having the liquid crystal layer 1 which was open for free passage by the reflective display 9 and the transparency display 10, and changing a cel gap.
[0362] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the transparency display 10, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 5 at the reflective display 9 list of the liquid crystal display obtained by this example using the criteria of common bearing.
[0363] In addition, the Gentlemen phase reference compensating plate which the optical arrangement shown in a table 5 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each bearing in a table 5 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0364]
[A table 5]

			実施例10	
			反射表示部9	透過表示部10
偏光板14		透過軸方位　(度)	0	
位相差補償板16	位相差補償板	遅相軸方位　(度)	15	
		リタデーション（nm）	270	
	位相差補償板	遅相軸方位　(度)	75	
		リタデーション（nm）	135	
液晶層1		基板4配向方位　(度)	−15	−15
		基板5配向方位　(度)	55	−15
位相差補償板17	位相差補償板	遅相軸方位　(度)	−15	
		リタデーション（nm）	115	
	位相差補償板	遅相軸方位　(度)	−75	
		リタデーション（nm）	270	
偏光板15		透過軸方位　(度)	90	

[0365] Next, actuation of each optical element in the gestalt of this operation is explained below. First, the case where the electrical potential difference is not impressed to the liquid crystal layer 1 is explained. In this case, according to orientation processing bearing of the orientation film 2-3 established, the orientation, i.e., each electrode substrate, of the substrate interface which touches this liquid crystal layer 1, orientation of the liquid crystal in the above-mentioned liquid crystal layer 1 is carried out. For example, with the liquid crystal display obtained in the above-mentioned example 10, when not mixing a chiral additive in a liquid crystal constituent, twist orientation is carried out to 70 left, and it is in the 0 times twist orientation condition which is not twisted by the transparency display 10 at

the reflective display 9.

[0366] For this reason, by the reflective display 9, when the electrical potential difference is not impressed to the liquid crystal layer 1, if deltan-d of the liquid crystal layer 1 is set as about 270nm, if the circular polarization of light carries out incidence of this liquid crystal layer 1, it will act so that the linearly polarized light may be made to change and penetrate it. It is changed into the circular polarization of light by the phase contrast compensating plate 16, and by the liquid crystal layer 1, the light which carries out incidence to the liquid crystal layer 1 from a polarizing plate 14 side is further changed into the linearly polarized light from the circular polarization of light, it reaches the reflective film 8 and is reflected. When the electrical potential difference is not impressed to the liquid crystal layer 1 in the above-mentioned liquid crystal display from being again changed into the transparency component of a polarizing plate 14 when the light reflected by the reflective film 8 is the linearly polarized light on the reflective film 8, the display of the reflective display 9 will be clear display.

[0367] Moreover, by the transparency display 10, when the electrical potential difference is not impressed to the liquid crystal layer 1, if deltan-d of the liquid crystal layer 1 is set as 250nm - about 270nm, the liquid crystal layer 1 will act as 1/2 wavelength plate. That is, when the circular polarization of light by which incidence was carried out to the liquid crystal layer 1 turns into the circular polarization of light by which incidence was carried out, and the circular polarization of light which intersects perpendicularly, for example, incidence of the right-handed circularly polarized light (right-handed-rotation circular polarization of light) is carried out, this right-handed circularly polarized light is changed into the left-handed circularly-polarized light (left-handed-rotation circular polarization of light), and when incidence of the left-handed circularly-polarized light is carried out, this circular polarization of light is changed into the right-handed circularly polarized light. The light which carried out incidence to the transparency display 10 passes a polarizing plate 15, it is changed into the circular polarization of light by the phase contrast compensating plate 17, and incidence is carried out to the liquid crystal layer 1 with it. In the above-mentioned example 10, the polarization condition is the counterclockwise circular polarization of light mostly, this circular polarization of light carries out incidence of the circular polarization of light by which incidence is carried out to the liquid crystal layer 1 from the above-mentioned phase contrast compensating plate 17 to the liquid crystal layer 1, and it is changed into the clockwise circular polarization of light. And in the phase contrast compensating plate 16, since the right-handed-rotation circular polarization of light is changed into the linearly polarized light of the transparency shaft orientations of a polarizing plate 14 and the left-handed-rotation circular polarization of light is changed into the linearly polarized light of absorption shaft orientations, when the electrical potential difference is not impressed to the liquid crystal layer 1 in the above-mentioned liquid crystal display, the display of the transparency display 10 will be clear display.

[0368] Next, the case where an electrical potential difference is impressed to the liquid crystal layer 1 is explained. If the electrical potential difference is impressed to the liquid crystal layer 1, irrespective of whether the liquid crystal in this liquid crystal layer 1 is the reflective display 9, or it is the transparency display 10, according to an electrical potential difference, orientation will be carried out at right angles to a substrate 4-5, and the above-mentioned polarization conversion operation will become weaker in connection with it. That is, in order that the circular polarization of light prepared by the phase contrast compensating plate 16-17 may pass the liquid crystal layer 1 as it is, also in the reflective display 9, a dark display is realized also in the transparency display 10.

[0369] In addition, in the above-mentioned example 10, the phase contrast compensating plate of a 115nm retardation is used for the phase contrast compensating plate 17. In order to realize the good circular polarization of light only with the phase contrast compensating plate 17, although it is desirable that it is about 135nm as for the retardation of this phase contrast compensating plate 17, in order that the retardation may not disappear thoroughly in an electrical potential difference with the practical liquid crystal layer 1 of the transparency display 10, the retardation of the above-mentioned phase contrast compensating plate 17 is set up so that good contrast may be acquired in consideration of this.

[0370] Moreover, the phase contrast compensating plate 16 has the operation which changes into the circular polarization of light of large wavelength the polarization condition of the light which carries out incidence to the liquid crystal layer 1 of the reflective display 9. And in the above-mentioned liquid crystal display, twist orientation of the liquid crystal layer 1 in the reflective display 9 is carried out 70 degrees, and the deltan-d is set as 270nm. For this reason, in the reflective display 9 in the above-mentioned liquid crystal display, the light which carries out incidence to the liquid crystal layer 1 is the circular polarization of light, and this circular polarization of light is changed into the linearly polarized light in the liquid crystal layer 1, passes the liquid crystal layer 1, and reaches to the reflective film 8. And the light which turned into the linearly polarized light on the reflective film 8 is reflected in the mirror plane of the reflective film 8, and even it passes each optical element in order of reverse, and becomes the linearly polarized light which has the oscillating electric field of transparency shaft bearing of a polarizing plate 14 eventually. For this reason, in the above-mentioned reflective display 9, it becomes clear display.
[0371] Moreover, the chiral agent which makes the orientation of liquid crystal produce a left twist of a proper is mixed in the used liquid crystal constituent. This chiral agent changes the helical pitch of a proper to the liquid crystal constituent with which this chiral agent was mixed with that addition. For this reason, this helical pitch is adjusted and it becomes possible to make the electrical-potential-difference dependency of lightness in agreement by the reflective display 9 and the transparency display 10 using the minimum electrical potential difference from which liquid crystal orientation begins to change with helical pitches changing.
[0372] Thus, the display property of a liquid crystal display given in the produced example 10 is shown in drawing 19. In addition, the display property shown in drawing 19 is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability).
[0373] In drawing 19, a curve 331 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 10, and a curve 332 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 10.
[0374] When not impressing an electrical potential difference, the above-mentioned liquid crystal display obtained in the example 10 performed clear display, and the display by the so-called Nor Marie White (NW) mode in which a reflection factor and permeability decrease with impression of an electrical potential difference realized it with this liquid crystal display, so that drawing 19 might show. Moreover, the above-mentioned liquid crystal display can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while being able to set up a contrast ratio almost to the same extent by the reflective display 9 and the transparency display 10, and it can realize the display excellent in visibility.
[0375] As mentioned above, both the things set up as a concrete means for changing liquid crystal orientation by the reflective display 9 and the transparency display 10 so that the twist angles of the liquid crystal layer 1 may differ by the reflective display 9 and the transparency display 10 are effective in order to realize a good display by the reflective display 9 and the transparency display 10.
[0376] In addition, although rubbing processing of bearing which is different by the reflective display 9 and the transparency display 10 is performed and twist orientation of the liquid crystal layer 1 of the reflective display 9 is carried out in the above-mentioned example 10 in order to change the twist angle of the liquid crystal layer 1 by the reflective display 9 and the transparency display 10 Although the liquid crystal layer 1 of the transparency display 10 used the combination which has not carried out twist orientation, especially the means for changing the twist angle of the liquid crystal layer 1 by the reflective display 9 and the transparency display 10 is not limited.
[0377] For example, it is (1) in addition to the above-mentioned combination shown in an example 10. The combination from which the twist angle and sense of the twist differ although twist orientation of

both the liquid crystal layer 1 in the reflective display 9 and the liquid crystal layer 1 in the transparency display 10 is carried out, (2) Although the liquid crystal layer 1 in the reflective display 9 is not twisted, the liquid crystal layer 1 in the transparency display 10 may use the combination currently twisted. (3) the dip (the so-called pre tilt) of the liquid crystal to a substrate 4-5 differs by the reflective display 9 and the transparency display 10 -- you may combine and come out. Moreover, (4) Change of the liquid crystal orientation in a substrate interface may be combined with other means of this invention, and it is (5). That from which a cel gap differs by the reflective display 9 and the transparency display 10, and (6) Electric fields may differ by the reflective display 9 and the transparency display 10.

[0378] [The gestalt 5 of operation]

Although each example in the gestalten 2-4 of said operation explained the configuration for realizing a good transparency display in a good reflective display list using the liquid crystal display in which liquid crystal is carrying out orientation to parallel to the substrate, with the gestalt of this operation, orientation bearing of liquid crystal explains a vertical liquid crystal display to a substrate like the example 1 in the gestalt 1 of said operation. However, with the gestalt of this operation, the design for performing the display which used the birefringence or optical activity (polarization conversion operation) of liquid crystal using the polarizing plate was performed, without mixing dichroism coloring matter in a liquid crystal layer. In addition, the same number is given to the component which has the function as the gestalt 4 of the gestalt 1 of the following and said operation - operation of explanation same for convenience, and the explanation is omitted.

[0379] In the liquid crystal display concerning the gestalt of this operation, a dielectric constant anisotropy uses negative liquid crystal for the liquid crystal layer 1. Moreover, the vertical orientation film which carries out orientation of the liquid crystal to the orientation film 2-3 which pinches the liquid crystal layer 1 vertically is used. In this case, although orientation of the liquid crystal molecule is carried out almost vertically to the substrate 4-5 (screen) while not impressing the electrical potential difference to the liquid crystal layer 1, with impression of an electrical potential difference, it inclines from [of a substrate 4-5] a normal, and orientation of it is carried out and it produces a polarization conversion operation to the light which passes in the direction of a normal of the layer of the layer-like liquid crystal layer 1.

[0380] In the liquid crystal display with which liquid crystal requires for the gestalt of this operation the difference between the liquid crystal display using the orientation film 2-3 which carries out orientation to a substrate at parallel, and the liquid crystal display concerning the gestalt of this operation, even if it does not impress an electrical potential difference, it is that liquid crystal carries out orientation in the direction of a normal of a substrate 4-5 to the layer of an interface with the electrode substrate in the liquid crystal layer 1. Then, with the gestalt of this operation, in order to use this effectively, in not impressing an electrical potential difference to a display, it uses NB (Nor Marie Black) mode which becomes a black display. Specifically by the reflective display 9, it displays on the liquid crystal layer 1 by carrying out incidence of the circular polarization of light. moreover, from the phase contrast compensating plate 16 used also for a reflective display acting on polarization of the outgoing radiation light from the liquid crystal layer 1 in the transparency display 10 The above-mentioned liquid crystal layer 1 is driven by the electrode pair which connects the reflective display 9 and the transparency display 10 electrically, and in order to realize a dark display simultaneously, in consideration of the liquid crystal layer 1 carrying out orientation at right angles to a substrate 4-5 also in a transparency display, incidence of the circular polarization of light is carried out to the liquid crystal layer 1. For this reason, in the combination of a polarizing plate 14-15 and the phase contrast compensating plate 16-17, the retardation of the phase contrast compensating plate arranged by the liquid crystal layer 1 at the near side among two or more phase contrast compensating plates which constitute the phase contrast compensating plate 17 is set as 135nm. Thereby, with the gestalt of this operation, good NB display is realizable.

[0381] Next, in the combination of a polarizing plate 14-15 and the phase contrast compensating plate

16-17 mentioned above, setting out of the liquid crystal layer 1 which gives good clear display is explained.

[0382] With the gestalt of this operation, as mentioned above, from [of a substrate 4-5] a normal, it inclines and orientation of the liquid crystal layer 1 is carried out with impression of an electrical potential difference. It is desirable to act so that the circular polarization of light may be changed into the linearly polarized light, and to act to the transparency display 10 to the reflective display 9, as this liquid crystal layer 1, so that the circular polarization of light may be changed into the circular polarization of light of the circumference of reverse where an electrical potential difference is fully impressed to this liquid crystal layer 1. When the above-mentioned liquid crystal layer 1 does the above-mentioned conversion operation so, good clear display can be realized.

[0383] In order for the above-mentioned liquid crystal layer 1 to do the above-mentioned conversion operation so, it is desirable to carry out orientation processing of the orientation film 2-3 so that liquid crystal may not be made to produce the twist, and not to use a chiral additive for a liquid crystal constituent. That is, it is desirable to set up the liquid crystal layer 1 so that it may change lambda/4 in the reflective display 9 and may change with impression of the electrical potential difference to this liquid crystal layer 1 lambda/2 by the transparency display 10, when the retardation of the liquid crystal layer 1 sets wavelength of incident light to lambda.

[0384] When being set up so that the thickness of the liquid crystal layer 1 in the reflective display 9 may differ from the thickness of the liquid crystal layer 1 in the transparency display 10, it is easy to set up, as the liquid crystal layer 1 was mentioned above so that the liquid crystal layer 1 may do the above-mentioned conversion operation so.

[0385] Although a concrete example is hereafter given and explained about the liquid crystal display concerning the gestalt of this operation, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0386] [Example 11]

In this example, the liquid crystal cell for liquid crystal impregnation from which liquid crystal thickness differs by the reflective display 9 and the transparency display 10 was produced by the production approach of the liquid crystal cell for liquid crystal impregnation of an example 1, and the same approach, and the vertical orientation film which has the operation which carries out orientation of the liquid crystal to the orientation film 2-3 vertically to a substrate 4-5 was used. Orientation processing was performed so that liquid crystal might incline on the above-mentioned orientation film 2-3 a little and might carry out orientation to it from normal bearing (perpendicular direction) of a substrate 4-5 by rubbing.

[0387] In this example, the liquid crystal thickness (d) in the reflective display 9 However, 3 micrometers, While liquid crystal thickness (d) in the transparency display 10 is set to 6 micrometers and a refractive-index difference (deltan) forms the liquid crystal layer 1 in a liquid crystal ingredient using the liquid crystal which has the negative dielectric constant anisotropy of 0.06 The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell, and the liquid crystal display was produced. The above-mentioned phase contrast compensating plate 16 and the phase contrast compensating plate 17 consisted of phase contrast compensating plates of every two sheets respectively.

[0388] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the transparency display 10, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 6 at the reflective display 9 list of the liquid crystal display obtained by this example using the criteria of common bearing.

[0389] In addition, the Gentlemen phase reference compensating plate which the optical arrangement shown in a table 6 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in

order of the actual arrangement from an observer side. Moreover, each bearing in a table 6 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.

[0390]

[A table 6]

<table>
<tr><td colspan="3" rowspan="2"></td><td colspan="2">実施例１１</td></tr>
<tr><td>反射表示部９</td><td>透過表示部１０</td></tr>
<tr><td colspan="2">偏光板１４</td><td>透過軸方位　（度）</td><td colspan="2">０</td></tr>
<tr><td rowspan="4">位相差補償板１６</td><td rowspan="2">位相差補償板</td><td>遅相軸方位　（度）</td><td colspan="2">１５</td></tr>
<tr><td>リタデーション（ｎｍ）</td><td colspan="2">２７０</td></tr>
<tr><td rowspan="2">位相差補償板</td><td>遅相軸方位　（度）</td><td colspan="2">７５</td></tr>
<tr><td>リタデーション（ｎｍ）</td><td colspan="2">１３５</td></tr>
<tr><td colspan="2" rowspan="2">液晶層１</td><td>基板４配向方位　（度）</td><td>－１５</td><td>－１５</td></tr>
<tr><td>基板５配向方位　（度）</td><td>－１５</td><td>－１５</td></tr>
<tr><td rowspan="4">位相差補償板１７</td><td rowspan="2">位相差補償板</td><td>遅相軸方位　（度）</td><td colspan="2">－１５</td></tr>
<tr><td>リタデーション（ｎｍ）</td><td colspan="2">１３５</td></tr>
<tr><td rowspan="2">位相差補償板</td><td>遅相軸方位　（度）</td><td colspan="2">－７５</td></tr>
<tr><td>リタデーション（ｎｍ）</td><td colspan="2">２７０</td></tr>
<tr><td colspan="2">偏光板１５</td><td>透過軸方位　（度）</td><td colspan="2">９０</td></tr>
</table>

[0391] Thus, the display property of a liquid crystal display given in produced this example is shown in drawing 20. In addition, a display property given in drawing 20 is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability).

[0392] In drawing 20, a curve 341 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 11, and a curve 342 shows the electrical-potential-difference dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 11.

[0393] When not impressing an electrical potential difference, the above-mentioned liquid crystal display obtained in the example 11 performed the dark display, and the display by the so-called NB mode which a reflection factor and permeability increase with impression of an electrical potential difference realized it with this liquid crystal display, so that drawing 20 might show. Moreover, the above-mentioned liquid crystal display can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while being able to set up a contrast ratio almost to the same extent by the reflective display 9 and the transparency display 10, and it can realize the display excellent in visibility.

[0394] According to the gestalt of this operation, as mentioned above, by the reflective display 9 and the transparency display 10 In the liquid crystal display concerning this invention which realizes simultaneously different liquid crystal orientation By using at least for one side the orientation means

(vertical orientation film) to which orientation of the liquid crystal is carried out at right angles to the substrate side which touches this liquid crystal (liquid crystal layer 1) among the reflective display 9 or the transparency display 10 It was checked that the transflective type liquid crystal display which can perform a good display by both the reflective display 9 and the transparency display 10 is realized.
[0395] [The gestalt 6 of operation]
With the gestalt of this operation, when displaying by changing liquid crystal orientation on an electrical potential difference, in either [at least] a reflective display or a transparency display, the liquid crystal display which displays by changing orientation bearing of liquid crystal is explained, maintaining the orientation condition of liquid crystal in the parallel condition to the screen (substrate). That is, in the liquid crystal display concerning the gestalt of this operation, a liquid crystal molecule rotates to parallel to the screen (substrate) in either [at least] a reflective display or a transparency display by impression of an electrical potential difference.
[0396] Although the liquid crystal display concerning the gestalt of this operation is hereafter explained using a concrete example, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples. In addition, the same number is given to the component which has the function as the gestalt 5 of the gestalt 1 of said operation – operation of explanation same for convenience, and the explanation is omitted.
[0397] [Example 12]
At this example, by using for transflective type liquid crystal the IPS (in plane switching) mode used in order for a transparency mold liquid crystal display to realize a wide-field-of-view angle, parallel are made to rotate a liquid crystal molecule to a substrate to a substrate by the horizontal electric field of field inboard, and the liquid crystal display which gave the optical switch function is explained below with reference to drawing 21 (a) and drawing 21 (b).
[0398] In addition, conventionally, although the IPS mode itself was used in the field of a transparency mold liquid crystal display, since liquid crystal orientation change was inadequate for a transparency display, the liquid crystal orientation on the above-mentioned Kushigata electrode was not able to be contributed to a display, and was not able to realize a good display on the Kushigata electrode used at the time of this IPS mode activity. However, according to this example, by the conventional IPS method, a reflective display can be realized in the field on Kushigata wiring which was not able to be used, and the utilization effectiveness of light can obtain a transflective type high liquid crystal display.
[0399] Drawing 21 (a) is an important section sectional view at the time of no electrical-potential-difference impressing the liquid crystal display concerning this example, and drawing 21 (b) is an important section sectional view at the time of electrical-potential-difference impression of the liquid crystal display shown in drawing 21 (a). In addition, drawing 21 (a) and drawing 21 (b) show a cross section when each cuts the liquid crystal cell in this liquid crystal display in respect of being vertical to bearing in which electrode wiring (terminal) of the Kushigata electrode in which it was prepared by this liquid crystal cell is prolonged.
[0400] The liquid crystal display shown in drawing 21 (a) and drawing 21 (b) the substrate 51 with which the liquid crystal layer 1 has translucency, and the Kushigata electrode 53 (the content rewriting means of a display --) which has light reflex nature While being pinched with the substrate 54 which possesses light reflex nature by having an electrical-potential-difference impression means and an orientation device and equipping the outside (namely, the opposed face with a substrate 54 opposite hand) of a substrate 51 with the phase contrast compensating plate 16 and a polarizing plate 14 further It has the configuration which equipped the outside (namely, the opposed face with a substrate 51 opposite hand) of a substrate 54 with the phase contrast compensating plate 17 and the polarizing plate 15. In addition, the phase contrast compensating plate 16 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 17 from this example.
[0401] In one [among the substrates of a couple with which, as for the above-mentioned liquid crystal

display, this example was also prepared on both sides of the above-mentioned liquid crystal layer 1] substrate 54 (electrode substrate) On a glass substrate 52, the sensitization resin which has insulation is applied with a spin coat, and sensitization resin does not remain in the transparency display 10 by the mask exposure of ultraviolet radiation further. In the reflective display 9 Pattern formation of the insulator layer 11 (orientation device) is carried out so that this sensitization resin may be formed in predetermined thickness. Thereby, the thickness of the liquid crystal layer 1 in the transparency display 10 is set up more thinly than the thickness of the liquid crystal layer 1 in the reflective display 9.

[0402] Moreover, in the above-mentioned liquid crystal display concerning this example, on the above-mentioned glass substrate 52, the Kushigata electrode 53 (orientation device) which has light reflex nature is formed so that the above-mentioned insulator layer 11 may be covered. This Kushigata electrode 53 is a reflective pixel electrode which serves both as the liquid crystal actuation electrode which drives the liquid crystal layer 1, and the reflective film (reflective means), and is produced with the metal with the high reflection factor of light.

[0403] In the above-mentioned liquid crystal display, the orientation condition of liquid crystal molecule 1a changes with the electric fields by which the seal of approval is carried out with the Kushigata electrode 53 by the transparency display 10. Moreover, in the reflective display 9, while the liquid crystal layer 1 drives by the electric field by the above-mentioned Kushigata electrode 53, the reflex action of the above-mentioned Kushigata electrode 53 is used for the display.

[0404] In addition, in this example, although wiring of the Kushigata electrode 53 is used for the reflective means, in order to give light-scattering nature to this Kushigata electrode 53, the film which has light-scattering nature may be further formed in the field which concavo-convex structure may be formed in the front face, and counters the Kushigata electrode 53 in the outside of a glass substrate 51.

[0405] In the liquid crystal display shown in drawing 21 (a) and drawing 21 (b), mutually different potential is given to Kushigata electrode 53aand53b which adjoins each other mutually, and electric field arise between the above-mentioned Kushigata electrode 53a and 53b. As shown in drawing 21 (b), the transparency display 10 is equivalent to the gap section of Kushigata electrode 53a and 53b, and in this part, liquid crystal orientation maintains bearing where that orientation bearing is parallel to a glass substrate 52, and changes with above-mentioned Kushigata electrode pairs (Kushigata electrode 53aand53b) a lot. Moreover, the reflective display 9 is equivalent to right above [of the Kushigata electrode 53 (Kushigata electrode 53aand53b)], and liquid crystal orientation changes also to vertical bearing in this part not only to change of bearing but to the glass substrate 52 along the flat surface of a glass substrate 52. This is because line of electric force has the component vertical to a glass substrate 52 by the reflective display 9 to line of electric force (a broken line showing among drawing) being mostly prolonged in parallel to a glass substrate 52 in the transparency display 10, as shown in drawing 21 (b).

[0406] Optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list, orientation bearing of liquid crystal) of the polarizing plate 14-15 in the transparency display 10, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 7 at the reflective display 9 list of the liquid crystal display concerning this example using the criteria of common bearing.

[0407] In addition, the Gentlemen phase reference compensating plate which the optical arrangement shown in a table 7 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 17 is indicated in order of the actual arrangement from an observer side.

[0408] Moreover, orientation bearing (orientation bearing of the major axis of liquid crystal molecule 1a) of the liquid crystal layer 1 is equal to rubbing processing bearing in substrate 51 front face in a substrate 51 side, and equal to rubbing processing bearing in substrate 54 front face in a substrate 54 side. Hereafter, substrate 51 orientation bearing and orientation bearing of the liquid crystal layer 1 by the side of a substrate 54 are described for orientation bearing of the liquid crystal layer 1 by the side

of a substrate 51 as substrate 54 orientation bearing.
[0409] Moreover, each bearing in a table 7 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0410] The direction where electrode wiring (terminal) of the Kushigata electrode 53 is prolonged here is 65-degree bearing, and it changed so that liquid crystal molecule 1a which liquid crystal orientation is with the transparency display 10 and the reflective display 9, and has turned to both bearings 75 degrees with impression of an electrical potential difference might have bigger bearing than bearing 75 degrees. Moreover, in the above-mentioned liquid crystal display, deltan-d of the liquid crystal layer [in / in deltan-d of the liquid crystal layer 1 in the reflective display 9 / 130nm order and the transparency display 10] 1 is set up before and after 240nm.
[0411]
[A table 7]

			実施例１２	
			反射表示部９	透過表示部１０
偏光板１４		透過軸方位　（度）	０	
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１５	
		リタデーション（ｎｍ）	２７０	
液晶層１		基板５１配向方位（度）	７５	７５
		基板５４配向方位（度）	７５	７５
位相差補償板１７	位相差補償板	遅相軸方位　（度）	－１５	
		リタデーション（ｎｍ）	２４０	
	位相差補償板	遅相軸方位　（度）	－７５	
		リタデーション（ｎｍ）	２７０	
偏光板１５		透過軸方位　（度）	９０	

[0412] In the liquid crystal display set up as mentioned above, when not impressing an electrical potential difference to the liquid crystal layer 1, both the reflective display 9 and the transparency display 10 become a dark display. And if an electrical potential difference is impressed to the liquid crystal layer 1 from this condition, that orientation bearing will change so that liquid crystal molecule 1a may swerve from bearing (the above-mentioned setting out 65-degree bearing) where electrode wiring (terminal) of the Kushigata electrode 53 is prolonged. Therefore, in the above-mentioned liquid crystal display, clear display is realized by changing orientation bearing of the liquid crystal at the time of electrical-potential-difference impression.
[0413] Thus, the produced display property of the liquid crystal display concerning this example is shown in drawing 22. In addition, a display property given in drawing 22 is measured by the same approach as an example 1, an axis of abscissa shows the actual value of applied voltage, and an axis of ordinate shows lightness (a reflection factor or permeability).
[0414] In drawing 22, a curve 351 shows the electrical-potential-difference dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 12, and a curve 352 shows the electrical-potential-difference dependency of the permeability of the transparency display 10

in the liquid crystal display obtained in the example 12. In addition, although the reflective display 9 has a difference in an optical property with the location on the Kushigata electrode 53, it has indicated the optical property of a typical part here.

[0415] When the above-mentioned liquid crystal display obtained in the example 12 does not impress an electrical potential difference so that drawing 22 may show, both the reflective display 9 and the transparency display 10 perform a dark display, and a reflection factor and permeability increase them with impression of an electrical potential difference with this liquid crystal display. Moreover, both the reflection factor of the reflective display 9 in case applied voltage is 2V, and the permeability of the transparency display 10 were 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 38% 35%. Therefore, according to the above-mentioned liquid crystal display, it can be [as opposed to / both / the transparency display 10] compatible in the lightness and the contrast ratio of clear display also to the reflective display 9, and the display excellent in visibility can be realized. Moreover, according to the above-mentioned liquid crystal display, from exceeding the contrast ratio in the reflective display 9, the contrast ratio in the transparency display 10 can raise display grace further, and can perform a good display.

[0416] As mentioned above, according to the above-mentioned example 12, by the conventional IPS method, the reflective display was realized in the field on the Kushigata wiring 53 which was not able to be used for the display, and it checked that the utilization effectiveness of light could obtain a transflective type high liquid crystal display.

[0417] In the gestalt of this operation, the approach of using a ferroelectric liquid crystal display mode besides the approach of using a pneumatic liquid crystal like the IPS mode mentioned above as an approach of realizing liquid crystal orientation mentioned above, the method of using antiferroelectricity liquid crystal display mode, etc. can be used.

[0418] So, the following examples 13 explain the liquid crystal display which used the ferroelectric liquid crystal display mode for the display as other liquid crystal displays which realize liquid crystal orientation mentioned above.

[0419] [Example 13]

In this example, a surface passivation ferroelectric liquid crystal is used for a liquid crystal ingredient in the liquid crystal display shown in an example 1. While it sets up so that liquid crystal thickness (d) may be set to 1.4 micrometers by the transparency display 10 and may be set to 0.7 micrometers by the reflective display 9, and setting up so that deltan-d of this liquid crystal layer 1 may be set to 130nm by the reflective display 9 and may be set to about 260nm by the transparency display 10 Instead of forming the reflective film 8 on the electrode 7 corresponding to the reflective display 9, the liquid crystal cell shown in an example 1 and the liquid crystal cell designed similarly were produced except having used the reflector for the field corresponding to the reflective display 9 as an electrode.

[0420] Pattern formation of the insulator layer 11 was carried out so that sensitization resin might not remain in the transparency display 10 but it might specifically be formed by the reflective display 9 on a substrate 5 (glass substrate) at the thickness this whose sensitization resin is 0.7 micrometers, the reflector was produced in this insulator layer 11 formation section (reflective display 9), and the transparent electrode was produced in the insulator layer 11 agenesis section (transparency display 10). And the electrode substrate was produced by forming the orientation film 3 on the above-mentioned electrode forming face in this substrate 5, and performing orientation processing by rubbing. In addition, the configuration of an electrode substrate (opposite substrate) which carries out opposite arrangement is the same as that of a thing given in an example 1 to this electrode substrate. And the ferroelectric liquid crystal constituent containing the above-mentioned surface passivation ferroelectric liquid crystal was introduced between the above-mentioned two-electrodes substrates, the liquid crystal cell was produced, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in this liquid crystal cell, and the liquid crystal display was produced. In addition, the phase contrast compensating plate 16 was constituted from a phase contrast

compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 17 from this example.
[0421] optical arrangement (namely, pasting bearing of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and a list -- orientation bearing of the liquid crystal of clear display and a dark display) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in a table 8 using the criteria of common bearing.
[0422] In addition, the Gentlemen phase reference compensating plate which the optical arrangement shown in a table 8 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 17 is indicated in order of the actual arrangement from an observer side. Moreover, each bearing in a table 8 expresses with the unit of whenever bearing from criteria bearing taken on the screen at arbitration, and the retardation of a Gentlemen phase reference compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0423]
[A table 8]

			実施例１３	
			反射表示部９	透過表示部１０
偏光板１４		透過軸方位　（度）	０	
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１５	
		リタデーション（ｎｍ）	２７０	
液晶層１		基板５１配向方位（度）	Ｄ：７５	Ｌ：７５
		基板５４配向方位（度）	Ｄ：７５	Ｌ：７５
位相差補償板１７	位相差補償板	遅相軸方位　（度）	－１５	
		リタデーション（ｎｍ）	２７０	
	位相差補償板	遅相軸方位　（度）	－７５	
		リタデーション（ｎｍ）	２７０	
偏光板１５		透過軸方位　（度）	９０	

Ｄ：暗表示を示すときの液晶配向方位
Ｌ：明表示を示すときの液晶配向方位

[0424] Thus, the produced liquid crystal display was a liquid crystal display which both has good lightness and a good contrast ratio by the reflective display 9 and the transparency display 10.
[0425] As mentioned above, if it is the liquid crystal display which realizes liquid crystal thickness in a simultaneously different liquid crystal orientation list by the reflective display 9 and the transparency display 10, even if the orientation change direction of the liquid crystal layer 1 by the seal of approval of an electrical potential difference changes in a liquid crystal layer flat surface, a display good as a transflective type liquid crystal display of this invention can be obtained. And when the above-mentioned liquid crystal display uses IPS mode, it is more possible than the conventional transparency mold liquid crystal display which similarly used IPS mode to improve the utilization effectiveness of light. Moreover, the above-mentioned liquid crystal display concerning the gestalt of this operation is usable also by the modes, such as a ferroelectric liquid crystal.

[0426] [The gestalt 7 of operation]
The gestalt of this operation explains the concrete component substrate and light filter substrate of active-matrix actuation which enable the configuration of the liquid crystal display concerning this invention.
[0427] When producing the liquid crystal display applied to this invention for the purpose of image display, it is important for the ratio of a transparency display and a reflective display practically to design according to the operating frequency of the case where it uses for a transparency display, and the case where it uses for a reflective display.
[0428] That is, the 1st activity gestalt is an activity gestalt (it abbreviates to transparency subject half transparency hereafter) which uses the transmitted light from the lighting system (back light) as a background lighting means for a main display, and uses a reflective display for prevention of a washout like the transparency mold liquid crystal display used now.
[0429] Moreover, the 2nd activity gestalt is an activity gestalt which uses a reflective display for a main display, its surrounding illumination light is weak while the light is often put out according to a situation and the large back light of power consumption aims at reduction of power consumption, and when the check of the content of a display cannot be performed only in a reflective display, it is the activity gestalt (it omits with reflective subject half transparency hereafter) which turns on and uses a back light.
[0430] In two kinds of such activity gestalten, since whether a main display is performed by transparency display differs from whether it carries out by reflective display, the design of the color of the ratio of the screen product of a transparency display and a reflective display and the light filter in the case of color display becomes a thing different, respectively.
[0431] Then, the liquid crystal display which uses for a display first the TFT component which is one of the active matrices is mentioned as an example, and the liquid crystal display of a transparency subject transflective type which made transparency the subject is explained below. In addition, the same number is given to the component which has the function as the gestalt 6 of the gestalt 1 of said operation – operation of explanation same for convenience, and the explanation is omitted.
[0432] First, the substrate structure of the liquid crystal display of a transparency subject transflective type of using a TFT component for a display is explained below with reference to drawing 23 (a) – drawing 25.
[0433] Drawing 23 (a) is the important section top view of the TFT component substrate for realizing the liquid crystal display of a transparency subject transflective type concerning the gestalt 7 of this operation, drawing 23 (b) is drawing showing the actuation electrode 19 of the reflective display 9 (refer to drawing 1, drawing 4, drawing 24, and drawing 25) in the TFT component substrate shown in drawing 23 (a), and drawing 23 (c) is drawing showing the transparence pixel electrode 20 in the TFT component substrate shown in drawing 23 (a).
[0434] Moreover, drawing 24 is the A–A' line view sectional view of the TFT component substrate shown in drawing 23 (a), and is drawing shown in the cross section which passes further along the auxiliary part by volume 26 in more detail the TFT component substrate shown in drawing 23 (a) through the TFT component 21 to the actuation electrode 19, and the transparence pixel electrode 20. Furthermore, drawing 25 is the B–B' line view sectional view of the TFT component substrate shown in drawing 23 (a), and shows the cross-section structure of the boundary part of adjacent pixels.
[0435] The pixel electrode 18 which drives the liquid crystal layer 1 (refer to drawing 1 and drawing 4) is constituted by the transparence pixel electrode 20 (the content rewriting means of a display, electrical-potential-difference impression means) which consists of the actuation electrode 19 (the content rewriting means of a display, electrical-potential-difference impression means) and ITO of the reflective display 9 as shown in drawing 23 (a), drawing 24, and drawing 25. In addition, the above-mentioned actuation electrode 19 may be a reflector with which itself has reflexibility. Moreover, in the case of the means of displaying in which not showing reversal of light and darkness even if the liquid crystal display method used for a display expresses as the same electrical potential difference, the actuation electrode

19 and the transparence pixel electrode 20 of each other may be connected electrically.
[0436] The above-mentioned actuation electrode 19 and the transparence pixel electrode 20 are connected to the drain terminal 22 of the TFT component 21 which controls the electrical potential difference used for a display by each pixel unit. Moreover, opening 19a for a transparency display is formed in the actuation electrode 19, and when the above-mentioned actuation electrode 19 is a reflector, this opening 19a formation field for a transparency display is used for a transparency display as a transparency display 10.
[0437] The TFT component 21, wiring 23 and wiring 24, the auxiliary part by volume 26, and the auxiliary capacity line 27 are arranged at the lower layer of the above-mentioned actuation electrode 19. However, with the gestalt of this operation, since construction material with protection-from-light nature, such as a metal, is used for these components, the above-mentioned TFT component substrate is produced so that these components may not be arranged in opening 19a for a transparency display. In addition, in drawing 23 (a), a two-dot chain line shows the actuation electrode 19.
[0438] Moreover, as shown in drawing 24, the main part of the actuation electrode 19 of this reflective display 9 that impresses an electrical potential difference to the reflective display 9 which constitutes the pixel electrode 18 is separated from substrate 19 front face (TFT component substrate side) in which the wiring 23-24 for actuation of the above-mentioned TFT component 21 and the above-mentioned TFT component 21 were formed by the organic compound insulator 25. This organic compound insulator 25 is formed so that it may be formed in an organic insulating material with a low dielectric constant and thickness may be set to 3 micrometers. The parasitic capacitance component formed between gate wiring of the TFT component 21, the becoming wiring 23, the wiring 24 used as the source wiring of the TFT component 21, and the pixel electrode 18 this It prevents that you delay the gate signal wave and source signal wave form which control the switching action of the TFT component 21, or make it distorted. While it is because the dot-matrix display with high resolution is enabled, it is for making good the optical property in the reflective display 9 and the transparency display 10 in the liquid crystal display concerning the gestalt of this operation.
[0439] The above-mentioned pixel electrode 18 is connected to the drain terminal 22 of the above-mentioned TFT component 21. This drain terminal 22 is n+ doped by n mold. It is an amorphous silicon layer and acts as a drain electrode of the TFT component 21. In the above-mentioned TFT component substrate concerning the gestalt of this operation, the ITO layer arranged so that this drain terminal 22 may be touched is used as a transparence pixel electrode 20, and the actuation electrode 19 of the reflective display 9 is formed on the organic compound insulator 25 by which patterning was carried out so that a part of that transparence pixel electrode 20 might be covered further. That is, with the liquid crystal display of a transparency subject transflective type using the TFT component substrate shown in drawing 24, the above-mentioned transparence pixel electrode 20 used for a transparency display and the above-mentioned actuation electrode 19 used for a reflective display are electrically connected in the pattern boundary section of an organic compound insulator 25. Moreover, smooth irregularity may be formed in the front face as shown in the actuation electrode 19 of the reflective display 9 for the purpose of mirror plane-ized prevention of the screen at drawing 24 and drawing 25.
[0440] Moreover, as shown in drawing 25, in the boundary part of the adjacent pixels in the above-mentioned TFT component substrate, an organic compound insulator 25 is formed so that the wiring 24 connected to the source terminal 28 of the TFT component 21 may be covered, and the actuation electrode 19 of the reflective display 9 is formed on this organic compound insulator 25.
[0441] Thus, since the produced TFT component substrate can control the parasitic capacitance component in which the pixel electrode 18 and wiring 23-24 form the relation between the thickness of an organic compound insulator 25, and a dielectric constant through an organic compound insulator 25 by setting up appropriately, as shown in drawing 23 (a), it can lengthen the actuation electrode 19 of the reflective display 9 to wiring 23 and right above [of 24]. In this case, since it becomes possible to design the gap of pixel electrode 18 adjacent comrades narrowly and the leakage electric field from the

wiring 23-24 to the liquid crystal layer 1 decrease in a pixel gap, the orientation of the liquid crystal layer 1 is a pile to turbulence. Therefore, by setting up appropriately the relation between the thickness of an organic compound insulator 25, and a dielectric constant, control of the liquid crystal orientation of the liquid crystal layer 1 is attained to near the boundary of pixel electrode 18 comrades, and can produce the TFT component substrate of the so-called high liquid crystal display of a transparency subject transflective type of a numerical aperture. With the gestalt of this operation, in the organic insulating material of 3.5, specific inductive capacity formed [thickness] the above-mentioned organic compound insulator 25 so that it might be set to 3 micrometers.

[0442] The area which can be used for a transparency display with the gestalt of this operation as mentioned above produced the TFT component substrate with which the area which can be used for a reflective display occupies 38% of the whole pixel 45% of the area of the whole pixel. It can say that it is the TFT component substrate of the high liquid crystal display of a transparency subject transflective type of the utilization effectiveness of the light which can be used for a display in order that this TFT component substrate may secure the rate of the almost equivalent transparency display 10 and may display by adding the display light reinforcement of the reflective display 9 to transparency display light as compared with the numerical aperture of the transparency display of the TFT-liquid-crystal display of the transparency mold used more widely than before being just over or below 50%.

[0443] Thus, high efficiency for light utilization is realizable with the gestalt of this operation, because it is possible to arrange the component which does not penetrate the light of the TFT component 21, wiring 23-24 and the auxiliary part by volume 26, and auxiliary capacity line 27 grade to the reflective display 9, and it is because the light used for a liquid crystal display with these components is not spoiled.

[0444] Next, the light filter substrate which is made to counter the TFT component substrate produced in this way, and is used is explained below with reference to drawing 26 (a) and drawing 26 (b).

[0445] As shown in the above-mentioned light filter substrate at drawing 26 (a) and drawing 26 (b), light filter 61 R.61G and 61B of three colors of red (R), green (G), and blue (B) are formed. Light filter 61 R.61G and 61B of these 3 color are respectively formed with the resin of optical photosensitivity which distributed the pigment, by the photolithography technique, on the glass substrate 62, is a coloring layer currently formed in the flat-surface configuration of the shape of a stripe doubled with the pixel of a TFT component substrate, and is separated and formed for every color.

[0446] furthermore, on light filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62 As shown in drawing 26 (b), so that these light filter 61 R.61G and 61B may be covered The smoothing layer 501 is formed with transparence acrylic resin, and on it as a counterelectrode 502 (the content rewriting means of a display, electrical-potential-difference impression means) of the pixel electrode 18 in a TFT component substrate ITO of 140nm thickness is formed by sputtering using the wrap electric shielding mask except the predetermined field. Thereby, the above-mentioned light filter 61 R.61G and 61B are separated in the transparent field for every color.

[0447] The physical relationship of the superposition of the above-mentioned light filter substrate and a TFT component substrate Opening 19for transparency display a of the actuation electrode 19 which is as being shown in drawing 26 (a), and was formed in the reflective display 9 of a TFT component substrate While (namely, the transparency display 10) is thoroughly covered with light filter 61 R.61G and 61B of the shape of a stripe of R, G, and B, in the reflective display 9 Only the part of the drawing direction of light filter 61 R.61G and 61B in the above-mentioned actuation electrode 19 is covered with the above-mentioned light filter 61 R.61G and 61B. Opposite arrangement of the transparence field between these light filter 61 R.61G and 61B is carried out to the field (parts other than the drawing direction of the above-mentioned light filter 61 R.61G and 61B) of others of the actuation electrode 19 formed in the reflective display 9.

[0448] Arrangement with the reflective display 9 and the transparency display 10, and light filter 61 R.61G and 61B is shown in drawing 27 combining the above-mentioned light filter substrate and a TFT

component substrate. drawing 27 -- a light filter -- a substrate -- TFT -- a component -- a substrate -- a liquid crystal display -- ****** -- using it -- a location -- superposition -- the above -- a light filter -- a substrate -- TFT -- a component -- a substrate -- drawing 26 -- (-- a --) -- it can set -- C-C -- ' -- a location -- having cut -- the above -- drawing 26 -- (-- a --) -- a publication -- a liquid crystal display -- an important section -- C-C -- ' -- a line -- a view -- a sectional view -- it is .

[0449] Thus, respectively, which light filter 61 R.61G and 61B of R, G, and B are formed by the transparency display 10, and parts other than the drawing direction of the above-mentioned light filter 61 R.61G and 61B in the reflective display 9 support the transparence field between the above-mentioned light filter 61 R.61G and 61B at it.

[0450] Light filter 61 R.61G and 61B used for a transparency display, and light filter 61 R.61G [same] and 61B act on a part of reflective display 9 by this, and light filter 61 R.61G and 61B do not act on the remaining reflective display 9. By this, also to a reflective display, a color display (color display) is attained and a reflection factor required for a reflective display can be secured.

[0451] In addition, the transparency color which appears in the light which penetrated the light filter substrate produced as shown in said drawing 26 (a) and drawing 26 (b) may have the same color as the transparency color of R, G, and B which are used in a transparency mold liquid crystal display for every R, G, B, and pixel, and may be further adjusted suitably according to an application.

[0452] In the combination of the TFT component substrate and light filter substrate which are shown in above-mentioned drawing 26 (a) and drawing 27 The transparency display 10 expresses all as the light which passes light filter 61 R.61G and 61B. The reflective display 9 The part performs the display using the same light filter 61 R.61G and 61B as the transparency display 10, it is the remaining part, and it shows without using light filter 61 R.61G and 61B. Since this runs short of lightness if light filter 61 R.61G and 61B of the transparency display 10 are used for the reflective display 9 as it is, it is because it aims at preparing the part which does not use light filter 61 R.61G and 61B in the reflective display 9, and compensating lightness.

[0453] Furthermore, in consideration of display light passing light filter 61 R.61G and 61B twice, high light filter 61 R.61G and 61B of lightness may be prepared in the reflective display 9 like the gestalt of this operation rather than light filter 61 R.61G and 61B in the transparency display 10.

[0454] Moreover, with the gestalt of this operation, it doubles in activity eye, light filter 61 R.61G and 61B are formed in the transparency display 10 at least, and it is good for the reflective display 9 also as a configuration which has the field (part) in which light filter 61 R.61G and 61B are not prepared, and good also as a configuration which uses light filter 61 R.61G and 61B only for the transparency display 10, and does not prepare light filter 61 R.61G and 61B in the reflective display 9.

[0455] When considering as the configuration which does not prepare light filter 61 R.61G and 61B in the reflective display 9, a display voltage signal required for a transparency display is a signal suitable for a color display, and a display voltage signal required for a reflective display is a signal suitable for monochrome display. For this reason, for example, although the rate which each pixel of R, G, and B contributes to lightness is proportional to the luminous transmittance (Y value) of each color in the transparency display 10, the trouble on actuation of completely becoming equal by each pixel arises in the reflective display 9.

[0456] Although the lightness in consideration of luminous transmittance differs in the transparency display 10 by which light filter 61 R.61G and 61B have been arranged when it is got blocked, for example, the lightness of the display with the case where only the pixel of the case where only the pixel of B is clear display, and G is clear display is measured, it is the nonconformity that lightness will become the same, in the reflective display 9 by which light filter 61 R.61G and 61B are not arranged.

[0457] The method of changing the area of the field which does not perform the color display of the reflective display 9 as an approach of preventing such nonconformity, according to Y value of each color of R, G, and B of light filter 61 R.61G and 61B used for a transparency display for every pixel of R, G, and B is mentioned. The contribution to the lightness from monochrome display of the reflective display

9 in each pixel of R, G, and B can be adjusted by changing the area of the reflective display 9 by this, and the lightness of monochrome display based on the area of this reflective display 9 can be made to reflect in each color specification brightness.
[0458] Moreover, there is same effectiveness also by designing the light filter coverage of the reflective display 9 so that it may become the order of G, R, and B from small order. According to this approach, there is also an advantage that some green coloring looked at by the further usual polarizing plate can be amended. Moreover, as shown in drawing 26 (a), when piling up and arranging a light filter substrate and a TFT component substrate, the location precision of the superposition of a TFT component substrate and a light filter substrate also has the advantage that it can take comparatively greatly. Since the light filter agenesis section of the reflective display 9 exists in the both sides of one pixel, this is for another side to decrease in number, when those either increases by location gap.
[0459] If the above TFT component substrates and a light filter substrate are used, when the transparency display is being performed According to concomitant use of the lighting system (back light) as a background lighting means, the same display as the TFT-liquid-crystal display of the conventional transparency display is attained. Furthermore, since the reflected light is performing the display near the content of a display of a transparency display also when an ambient light is very strong, the color liquid crystal display of the high resolution which the check of the content of a display is attained, does not have a washout even when an ambient light is strong, and does not have parallax is realizable.
[0460] Next, the configuration of a TFT component substrate and a light filter substrate is changed, the reflected light of an ambient light is used for a display, a main operating condition is used as a liquid crystal display with little power consumption, and only when the reinforcement of an ambient light is not enough, the substrate structure of the liquid crystal display of a reflective subject transflective type where a transparency display is used is explained below with reference to drawing 28, drawing 29 (a), and drawing 29 (b).
[0461] Drawing 28 is the important section top view of the TFT component substrate for realizing the liquid crystal display of a reflective subject transflective type concerning the gestalt 7 of this operation, and shows the configuration of the TFT component substrate which made the echo the subject. In addition, in drawing 28, a two-dot chain line shows the actuation electrode 19.
[0462] As shown in drawing 28, the liquid crystal display of the above-mentioned reflective subject transflective type has the same configuration as the liquid crystal display of said transparency subject transflective type except having set up smaller than it in the TFT component substrate used for the liquid crystal display of said transparency subject transflective type the magnitude of opening 19a for a transparency display in the actuation electrode 19, and the magnitude of the transparence pixel electrode 20.
[0463] That is, as the pixel electrode 18 which drives the liquid-crystal layer 1 (refer to drawing 1 and drawing 4) is shown in drawing 28, it is constituted by the transparence pixel electrode 20 which consists of the actuation electrode 19 and ITO of the reflective display 9, and the above-mentioned actuation electrode 19 and a transparence pixel electrode 20 are connected to the drain terminal 22 of the TFT component 21 which controls the electrical potential difference used for a display by each pixel unit also in the liquid crystal display of the above-mentioned reflective subject transflective type. Moreover, opening 19a for a transparency display is formed in the actuation electrode 19, and when the above-mentioned actuation electrode 19 is a reflector, this opening 19a formation field for a transparency display is used for a transparency display as a transparency display 10 (refer to drawing 24, drawing 25, and drawing 27).
[0464] Moreover, the TFT component 21, wiring 23 and wiring 24, the auxiliary part by volume 26, and the auxiliary capacity line 27 are arranged, and these components are arranged at the lower layer of the above-mentioned actuation electrode 19 so that it may not be arranged in the above-mentioned opening 19a for a transparency display.
[0465] However, the TFT component substrate shown in drawing 28 has the rate of the transparency

display 10 more smaller than the TFT component substrate used for the liquid crystal display of said transparency subject transflective type shown in drawing 23 (a) - drawing 27, and it is set up so that the rate of the reflective display 9 (refer to drawing 24, drawing 25, and drawing 27) may become large.
[0466] Thus, with the gestalt of this operation, the area which can be used for a transparency display produced the TFT component substrate with which the area which can be used for a reflective display occupies 70% of the whole pixel 13% of the area of the whole pixel as a TFT component substrate for the liquid crystal displays of a reflective subject transflective type.
[0467] The rate of the transparency display 10 in the TFT component substrate for the liquid crystal displays of the above-mentioned reflective subject transflective type is small as compared with 13% and the rate of the transparency display 10 in the TFT component substrate for the liquid crystal displays of said transparency subject transflective type. However, since the liquid crystal display of a reflective subject transflective type using this TFT component substrate can aim at reduction of power consumption by limit of the burning time amount of the lighting system (back light) as a background lighting means when a reflective display performs a transparency display only within the case where the content of a display cannot be checked, it can secure sufficient practicability.
[0468] Next, the configuration of the light filter substrate used combining this TFT component substrate is explained below with reference to drawing 29 (a) and drawing 29 (b).
[0469] As shown in drawing 29 (a) and drawing 29 (b), also to the light filter substrate for the liquid crystal displays of a reflective subject transflective type Like the light filter substrate for the liquid crystal displays of a transparency subject transflective type shown in drawing 26 (a) and drawing 26 (b) On a glass substrate 62, light filter 61 R.61G and 61B of three colors of red (R), green (G), and blue (B) are formed in the shape of a stripe. On light filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62 The smoothing layer 501 is formed with transparence acrylic resin so that these light filter 61 R.61G and 61B may be covered. On it as a counterelectrode 502 of a TFT component pixel electrode ITO is formed by sputtering using the wrap electric shielding mask except the predetermined field.
[0470] However, the light filter substrate for the liquid crystal displays of a reflective subject transflective type shown in drawing 29 (a) and drawing 29 (b) is set up so that the flat-surface configuration of light filter 61 R.61G and 61B and the spectral transmittance for every color may differ from the light filter substrate for the liquid crystal displays of a transparency subject transflective type shown in drawing 26 (a) and drawing 26 (b).
[0471] Specifically in the light filter substrate for the liquid crystal displays of a reflective subject transflective type Light filter 61 R.61G and 61B are formed so that the reflective display 9 of a TFT component substrate may be altogether covered by light filter 61 R.61G and 61B (coloring layer). And this light filter 61 R.61G and 61B By the reflective display 9, it is produced by high lightness so that display light may pass light filter 61 R.61G and 61B twice and may become good lightness in consideration of display light passing light filter 61 R.61G and 61B twice, so that a good display may be shown in a reflective display.
[0472] For this reason, in the reflective display 9, as mentioned above, a good reflective display is realized with the combination of a TFT component substrate with the large rate of the reflective display 9, and the light filter substrate set by it as mentioned above.
[0473] Moreover, although the rate of opening 19a for a transparency display is small in the transparency display 10, also in the transparency display used only within the case where an ambient light is inadequate, the content of a display can be checked according to concomitant use of the lighting system (back light) as a background lighting means. The liquid crystal display of a reflective subject transflective type applied to the gestalt of this operation at this point differs from the conventional reflective mold liquid crystal display. Although the liquid crystal display of a reflective subject transflective type concerning the gestalt of this operation has inadequate saturation when light filter 61 R.61G and 61B adjusted to the reflective display perform a transparency display, the check of a

foreground color is possible.
[0474] When the liquid crystal display of the above-mentioned reflective subject transflective type performs color display, so, to each pixel Light filter 61 R.61G and 61B are allotted to a reflective display at least, and color display is performed. To the transparency display 10 Especially the thing for which light filter 61 R.61G and 61B which has the saturation more than light filter 61 R.61G and 61B allotted to the reflective display 9 at a part of transparency display [at least] 10, and an EQC, not using light filter 61 R.61G and 61B are allotted is effective.
[0475] Thus, with the liquid crystal display of the above-mentioned reflective subject transflective type, light filter 61 R.61G and 61B are formed in a reflective display at least, and the transparency display 10 is good also as a configuration which has the field (part) in which light filter 61 R.61G and 61B are not prepared, and may perform monochrome display to the transparency display 10 by the transparency display 10, without using light filter 61 R.61G and 61B. Since the permeability of light rises in the case of the latter, it is possible to set up the transparency display 10 still smaller. Thereby, the area of the reflective display 9 can be secured more greatly and a better display can usually be obtained in the reflective display at the time of an activity.
[0476] In this case, like the liquid crystal display of a transparency subject transflective type, also in the liquid crystal display of the above-mentioned reflective subject transflective type, the area of the display which does not perform a color display, i.e., the area of a field which does not perform the color display of the transparency display 10 in this case, may be doubled with Y value of each color of R, G, and B of light filter 61 R.61G and 61B, and it may be changed for every pixel of R, G, and B. That is, in order to set up the contribution to the lightness of monochrome display of the transparency display 10 in each pixel of R, G, and B proper in consideration of luminous transmittance, each above-mentioned substrate may be produced so that the rates of a transparency screen product may differ for every pixel of R, G, and B.
[0477] On the other hand, it is strengthening the illumination light of this lighting system (back light) enough, although the power consumption at the time of lighting-system (back light) burning as a background lighting means increases, and it is also possible to use the light filter of high saturation set by the transparency display 10 at the transparency display. In this case, not only saturation but the color repeatability of a transparency display is also securable. It is important to make burning time amount of the above-mentioned lighting system (back light) into the minimum in the case of which in order to reduce power consumption.
[0478] As mentioned above, according to the gestalt of this operation, while power consumption is reducible in anticipated use, the liquid crystal display of a reflective subject transflective type which cannot start a washout by the reflective display 9, and can perform the transparency display using a background lighting means (back light) if needed is realizable.
[0479] In addition, although the amorphous silicon TFT component of a bottom product gate mold was mentioned as the example and explained as this TFT component 21 by the above-mentioned explanation while using the TFT component 21 as a switching element of an active matrix, especially as the above-mentioned switching element used in the gestalt of this operation, it may not be limited to this and you may be the MIM (Metal Insulator Metal) component which are a poly-Si TFT component and 2 terminal component. Moreover, it cannot be overemphasized that it is not necessary to necessarily use these active components.
[0480] Moreover, in each liquid crystal display concerning the gestalt of this operation, as mentioned above, only the thickness of an organic compound insulator 25 can change liquid crystal thickness by the reflective display 9 and the transparency display 10 by using the TFT component substrate which has the structure which separated the actuation electrode 19 which is an electrode for a display, and wiring 23-24 by the organic compound insulator 25. And in these liquid crystal displays, even if it sets the thickness of the above-mentioned organic compound insulator 25 as the value of about 3 micrometers whose high capacity display is attained from wiring resistance of a TFT component

substrate, and the point of parasitic capacitance, as shown in the gestalten 1 and 2 of said operation, realizing a good display by both the above-mentioned reflective display 9 and the transparency display 10 can acquire a liquid crystal thickness difference possible enough.

[0481] Therefore, the liquid crystal display in which a high capacity display is possible is realizable by adopting the TFT component substrate which has the structure indicated to drawing 23 (a) or drawing 28, and a liquid crystal display method given in the gestalten 1 or 2 of operation.

[0482] Furthermore, the TFT component substrate of structure using the organic compound insulator 25 which was mentioned above is already put in practical use in part in the liquid crystal display of the usual TFT component actuation method of only a transparency display, a mass production top also has few technical technical problems, and its practicability is high.

[0483] In addition, in the reflective mold liquid crystal display, invention-in-this-application persons are the objects, such as mirror plane-ized prevention of the screen, gave smooth irregularity to the reflective film and have repeated examination on it about production of the reflective film of a good reflection property. Consequently, also in the organic compound insulator 25 used in this invention, irregularity is formed in the part corresponding to the reflective display 9 in the TFT component substrate for the liquid crystal displays of a transparency subject transflective type which finds out that production of the same concavo-convex side is possible, and shows it to drawing 23 (a) - drawing 27.

[0484] As mentioned above, with the gestalt of this operation, there are two kinds of activity gestalten of a transparency subject transflective type and a reflective subject transflective type in the activity gestalt of a liquid crystal display, and it explained that the designs of the color of the ratio of the screen product of a transparency display and a reflective display and the light filter in the case of color display differed, respectively by whether a main display is performed by transparency display, or it carries out by reflective display.

[0485] So, the gestalt 8 of the following operations explains the ratio of the transparency display and reflective display in the liquid crystal display concerning this invention.

[0486] [The gestalt 8 of operation]

The ratio of a transparency display and a reflective display needs to be set up in consideration of visibility. the brightness (perception lightness) in consideration of the adaptation phenomenon of people's vision perceived by vision -- Stevens Etc. ("Brightness Function : Effect of Adaptation", Journalof the Optical Society of America, Vol.53, No.3, p375) etc. It is investigated. According to this reference, even if human being's eyes are the times of seeing the thing of the same brightness, depending on the brightness to which the brightness perceived has adapted itself, it turns out that there is quantity-relation to there.

[0487] drawing 30 -- Stevens etc. -- the relation between the adaptation luminance which gives the perception lightness of the equivalence to 5bril which changed and produced the unit from reference - 45bril, and sample brightness is shown. In drawing 30, as for an axis of abscissa, those who will observe a sample from now on show the adaptation luminance (unit: cd/m2) which has adapted itself by then, and the axis of ordinate shows the brightness (sample brightness (unit: cd/m2)) of the sample which the man was shown.

[0488] Setting to drawing 30, Point A is 1 cd/m2. The persons adapting to adaptation luminance are 10 cd/m2. It is the perception lightness when observing the sample which has a brightness side, and Point B is 1700 cd/m2. The persons adapting to adaptation luminance are 300 cd/m2. The perception lightness when observing the sample which has a brightness side is expressed. Since both perception lightness is the same values (9.4bril) at Point A and Point B, drawing 30 shows that people's perception-lightness is influenced by not only the brightness of the screen but adaptation luminance.

[0489] Then, adaptation of the observer of the screen of a liquid crystal display is considered below. First, the object to which an observer adapts himself is considered. When people observe a certain object and adapt themselves to the brightness of that object, that object that adapts itself is the brightness of the front face of the object set as the check-by-looking object around visual environment,

and, generally it depends for the brightness of the front face of the object used as this object for a check by looking on various environmental conditions. However, it is useful to assume that the object for adaptation is taken into consideration, i.e., the reflector in which the front face of an observation object reflects an ambient light, as one index, and to take this case into consideration. It is because it is natural to think that there is than the situation that the situation which people look at the light source itself which is emitting light, and adapts itself to it adapts itself to the reflector of the object illuminated by that light source even if this reason is the interior of a room and it is the outdoors. [few] Hereafter, adaptation of an observer who is accommodating vision to the reflector of an observation object is considered.

[0490] When the brightness side of an observation object is a reflector, adaptation luminance given in drawing 30 is shown by the value which multiplied the illuminance in the object side by the source of the illumination light which illuminates the object side where an observer adapts himself by the fixed value. When an illuminance is set to L (unit: lux (lux)) and brightness is set to B (unit: cd/m2), the brightness (B) of the field where the reflection factor to a perfect reflecting diffuser has the reflection factor of R serves as B=LxR/pi. Here, it is appropriate to take into consideration the brightness of the field of Munsell color charts N5 illuminated by a certain illuminance using the reflection factor of the field of Munsell color charts N5 said to have the average reflection factor for [of the usual human being] observation as adaptation luminance. In this case, R is set to 0.2.

[0491] Furthermore, it is assumed that not only the field of Munsell color charts N5 for adaptation but the object sample side where perception lightness is evaluated under the adaptation condition is illuminating simultaneously the source of the illumination light which is illuminating the field of Munsell color charts N5 which are the representation for observation. It is connected with the illuminance to which the perception lightness of the reflective display in the case of observing a liquid crystal display illuminates that liquid crystal display through adaptation luminance by this assumption. By this, concrete selection of the rate of a reflection factor and the area of a reflective display is attained based on the data of a mental physics experiment.

[0492] According to an invention-in-this-application person's etc. examination, the concrete rule of thumb of perception lightness can be put in another way to lightness as shown in a table 9. This reproduces some combination of adaptation luminance and sample brightness actually, results in the conclusion that such a lightness expression is appropriate, and serves as a scale of setting out of the reflective display by perception lightness.

[0493]

[A table 9]

知覚明度（単位：ｂｒｉｌ）	
０以上、　５未満	暗すぎてよく見えない
５以上、１０未満	暗い
１０以上、２０未満	普通
２０以上、３０未満	明るくて良く見える
３０以上	眩しい

[0494] Here, since the typical reflection factor (R) of a reflective mold liquid crystal display becomes about 30% by the polarizing plate method, this numeric value is used and actuation of the transflective type liquid crystal display concerning this invention is explained.

[0495] The straight line 601 given in drawing 30 shows actuation of a display of the liquid crystal display

of 30% of reflection factors. That is, when the illuminance of the source of the illumination light which illuminates the brightness side where an observer adapts himself is set to L (unit: lux), since the adaptation luminance by the field of Munsell color charts N5 requires the reflection factor (R= 20%) of the field of these Munsell color charts N5 for the brightness (L/pi) of the perfect reflecting diffuser illuminated by the same lighting, it serves as 0.2x L/pi. Similarly, the sample brightness of the screen of the liquid crystal display (object sample) whose reflection factor illuminated by the same lighting is 30% serves as 0.3x L/pi. That is, the straight line which plotted respectively the point of having changed an illuminance (L) variously and filling the relation of axis-of-abscissa 0.2 L/pi and axis-of-ordinate 0.3 L/pi, and was obtained is a straight line 601. Moreover, the straight line which plotted respectively the point of filling the relation of axis-of-abscissa 0.2 L/pi and axis-of-ordinate 0.1 L/pi by making into an object sample the liquid crystal display which has 10% of reflection factor like the case where the above-mentioned liquid crystal display which has 30% of reflection factor is made into an object sample, and was obtained is a straight line 602.

[0496] Next, the usable environment of the above-mentioned liquid crystal display where it has 30% of reflection factor is considered below. The adaptation luminance according [on the illuminance (about 100,000 luxs) of the direct light at the time of the fine weather which is the brightest lighting conditions that people experience in everyday life, and] to the field of Munsell color charts N5 is about 6000 cd/m2. It becomes. At this time, the perception lightness of the screen of a liquid crystal display which has 30% of reflection factor is adaptation luminance 6000 cd/m2, as shown in drawing 30. As it is set to about 30 bril(s) which are the perception lightness in the intersection of the straight line 605 and straight line 601 which are shown and was shown in a table 9, it is the value which senses dazzle. Moreover, the perception lightness under lighting darker than this is a value lower than the above-mentioned perception lightness, and the illuminance which can secure perception lightness 10bril becomes about 450 luxs by counting backward the formula mentioned above using the numeric value of the corresponding adaptation luminance. That is, although 450 luxs and the maximum illuminance become 100,000 luxs and the above-mentioned liquid crystal display has the usable minimum illuminance in the interior of a room (for example, interior of a room which attached lighting 450 luxs or more) used as the outdoors of the usual daytime, and the illuminance of 450 luxs or more when you need the clear display of 10 or more brils and 30 brils or less temporarily, a dark place is not enough as an illuminance and it becomes difficult from it to perceive it in it.

[0497] Moreover, a straight line 603 (drawing 30) shows the relation between the adaptation luminance when making a reflection factor into 50%, and sample brightness. When a reflective display is realized with 50% or more of reflection factor, under high illuminance environments (for example, the interior of a room of a bright place by the window, the direct sunlight lower, etc.) 1800 luxs or more, perception lightness will exceed 30bril(s) like the usual white paper, so that this straight line 603 may show. This shows what white paper senses dazzling in such an environment. Therefore, it is unsuitable from the point of visibility to use the screen which has 50% or more of reflection factor in this way under a high illuminance environment, and when performing a reflective display under such an environment, the reflection factor of the screen (brightness side) is understood that it is desirable that it is about 30%.

[0498] On the other hand, the illuminances which are shown in a straight line 601-602 and which give the perception lightness of 10bril in a reflective display at 30% of reflection factors and a reflective display at 10% of reflection factors are about 450 luxs and 3000 luxs respectively. That is, if a reflection factor is set to one third, it will be necessary to give 6.7 times brighter lighting. This shows that people's eyes will need to adapt themselves to bright reflectors other than a liquid crystal display, and will need to strengthen lighting more than the inverse number of the change ratio of a reflection factor, if lighting is strengthened, since the reflection factor of a liquid crystal display fell.

[0499] Furthermore, the display in the display object (for example, common luminescence mold display) which has fixed brightness has the trouble of sensing very dark especially in being bright in a perimeter so that drawing 30 may show.

[0500] However, in the transflective type liquid crystal display concerning this invention, the sum of the fixed brightness determined with the background illumination light and permeability in a transparency display and the brightness (sample brightness) determined with the fixed reflection factor in a reflective display is used for a display. That is, in the transflective type liquid crystal display concerning this invention, the display by the display brightness shown in the curve 604 shown in drawing 30, for example is realized. With the transflective type liquid crystal display concerning this invention, visibility is secured by reflective display, and as shown in this curve 604, when the illuminance of lighting is high, when the illuminance of lighting is low, visibility can be secured by the transparency display which used the lighting system (back light) as a background lighting means.
[0501] Furthermore, the result of having changed the illuminance using the display brightness of the transflective type above-mentioned liquid crystal display, and having searched for perception lightness is shown in drawing 31. Moreover, the relation of the illuminance and perception lightness in the liquid crystal display of a reflective mold is collectively shown in the relation of the illuminance and perception lightness in the liquid crystal display of a transparency mold, and a list as a comparison at drawing 31. Here, the illuminance in the field where, as for count of the above-mentioned perception lightness, 2000 cd/m2 and an observer have adapted [transmission / in case 30% and all viewing areas are transparency color displays about a reflection factor in case all viewing areas are reflective color displays] themselves in 7.5% and back light brightness was equal to the illuminance in the screen of a liquid crystal display, and the reflection factor of the field for adaptation was made into 20% supposing the lightness of Munsell color charts N5.
[0502] In drawing 31, the value of the perception lightness when changing an illuminance changes with rates (Sr) of the reflective display of the field in the transflective type above-mentioned liquid crystal display which can be displayed. A curve 611 shows the relation of the illuminance and perception lightness in Sr=0, i.e., the usual transparency mold liquid crystal display which does not perform a reflective display only by transparency display. the brightness of the screen in this transparency mold liquid crystal display -- 150 cd/m2 it is -- perception lightness is set to 10 or less brils when an illuminance is about 6000 luxs or more. Therefore, in order to secure the perception lightness of 10 or more brils by changing a part of transparency display into a reflective display, as shown in a curve 612, it is necessary to make into a reflective display 1/1 [Sr=0.], 10 [i.e.,] of the field which can be displayed, of area.
[0503] Moreover, a curve 613 is a curve which shows the relation of the illuminance and perception lightness in Sr=1, i.e., the reflective mold liquid crystal display which performs only a reflective display. The reflection factor of the screen of this reflective mold liquid crystal display is 30% in the comparison with a perfect reflecting diffuser, and perception lightness is set to 10 or less brils when an illuminance is about 450 luxs or less. Therefore, in order to secure the perception lightness of 10 or more brils by changing a part of reflective display into a transparency display, as shown in a curve 614, it is necessary to prepare Sr=0.9, i.e., 1/10 of the field which can be displayed of the transparency displays of area.
[0504] Moreover, while it turns out in the Sr values 0.1-0.9 that perception lightness can perform the good display of 10 or more brils and less than 30 brils according to drawing 31, when Above Sr is set as 0.30 (curve 615) or 0.50 (curve 616), it turns out that perception lightness can perform the bright good display of 20 or more brils and less than 30 brils.
[0505] Moreover, a surface echo arises on the surface of a liquid crystal display. The operation of the display active jamming by this surface echo is so remarkable that a surrounding illuminance is large. The relation of the perception lightness and the illuminance by this surface echo is collectively shown in above-mentioned drawing 31 (curve 617). Although a surface echo is greatly influenced by surface treatment, it shows the relation between the perception lightness of the field when the surface echo produced in the interface of the medium of a refractive index 1.5 and air has the same diffusibility as the perfect diffuse surface (namely, when the reflection factor by surface echo is 4%), and an illuminance with a curve 617. Therefore, if a surface echo is taken into consideration, it is desirable [the area of a

reflective display] that it is 30% or more (namely, Sr>=0.3) of the sum of the area of a reflective display and the area of a transparency display, when performing a better display.
[0506] When performing a color display by both the reflective display and the transparency display according to the above analysis according to the gestalt of this operation, and the percentages of the area of the reflective display in the sum of the area of a reflective display and the area of a transparency display are 30% or more and 90% or less, it turns out that a good display can be performed.
[0507] In addition, although it is possible to analyze the rate of the area of each display for performing a good display by the approach mentioned above and the same approach also when not using color display at least for one side among a reflective display and a transparency display A good display can be realized when it is within limits which the rate of the area of the reflective display which can be set mentioned above also in any sum of the area of a reflective display, and the area of a transparency display or case. In addition, as for the rate of the area of the reflective display in the sum of the area of a reflective display, and the area of a transparency display, the liquid crystal display of a transparency subject transflective type of a publication and the liquid crystal display of a reflective subject transflective type are produced by the gestalt 7 of the above-mentioned operation at a rate that the above is desirable.
[0508] [The gestalt 9 of operation]
Although the gestalt of this operation more specifically gives and explains a concrete example about the liquid crystal display of the active-matrix mold using a liquid crystal display method given in the gestalt 1 of said operation, and the gestalt 2 of operation, and the liquid crystal display which realized color display using the TFT component substrate, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0509] The making process of the liquid crystal display of the above-mentioned active-matrix mold concerning the gestalt of this operation consists of the process which produces a TFT component substrate, the process which produces a light filter substrate, a process which produces the liquid crystal cell for liquid crystal impregnation using these TFT(s) component substrate and a light filter substrate, and a process which injects liquid crystal into the obtained liquid crystal cell for liquid crystal impregnation, and is assembled as a liquid crystal display.
[0510] Then, the manufacture approach of the liquid crystal display of the active-matrix mold applied to each following example in the gestalt of this operation is first explained sequentially from the making process of the above-mentioned TFT component substrate.
[0511] The TFT component substrate has the configuration the TFT component 21 was formed for every pixel of whose process shown below on the substrate 29 which has translucency, as shown in drawing 23 (a) - drawing 25.
[0512] The glass substrate which consists of alkali free glass which does not contain an alkali component as the above-mentioned substrate 29 which forms the above-mentioned TFT component 21 was used. First, wiring 23 and the auxiliary capacity line 27 were formed on this substrate 29 by forming membranes by sputtering and carrying out patterning of the tantalum used as wiring 23 and the auxiliary capacity line 27 as gate wiring further. At this time, the open circuit is prevented by carrying out patterning of these wiring 23 and the auxiliary capacity line 27 so that the level difference of each wiring (wiring 23, auxiliary capacity line 27) may become gently-sloping, and making good coat nature of the below-mentioned wiring 24 formed after these wiring.
[0513] Furthermore, the tantalum oxide (Ta 2O5) layer was formed in the above-mentioned wiring 23 and the auxiliary capacity line 27 according to the anodic oxidation process, and the silicon nitride which serves as gate dielectric film on it was formed on them. furthermore, the chemical vapor deposition (CVD) which used mono-silane gas for the hydrogenation amorphous silicon layer as an intrinsic-semiconductor layer (i layers) and the silicon nitride layer as an etching stopper layer used as the switching field of the TFT component 21 on it at this order -- it formed by law and sputtering (silicon nitride). Next, n+ which becomes the source terminal 28 of the TFT component 21, and the drain

terminal 22 by CVD using the mono-silane gas which mixed phosphoretted hydrogen gas after carrying out patterning of the silicon nitride layer as an etching stopper layer of the maximum upper layer The layer was formed. Subsequently, above-mentioned n+ Patterning of a layer and the i layers was carried out, and patterning of gate dielectric film was performed further. At this time, the silicon nitride for a connection terminal area of the viewing-area exterior in wiring 23 (gate wiring) was removed collectively.
[0514] Next, ITO used as the transparence pixel electrode 20 was formed by sputtering so that the source terminal 28 and the drain terminal 22 might be contacted, and the tantalum used as the wiring 24 as source wiring was further formed by sputtering. Patterning of this tantalum was carried out, it considered as wiring 24, patterning of the ITO film currently formed by that lower layer was carried out further, and the transparence pixel electrode 20 was formed. This transparence pixel electrode 20 is in contact with the source terminal 28 and the drain terminal 22, as mentioned above, and the role which forms the ohmic contact of these terminals (source terminal 28, drain terminal 22) and wiring 23-24 is also played.
[0515] Next, the organic compound insulator 25 which has concavo-convex structure on a front face is formed as an insulator layer for reflective displays on the above-mentioned TFT component 21. The aluminum which serves as the actuation electrode 19 of the reflective display 9 so that the transparence pixel electrode 20 may be touched in the contact hole used as opening for a transparency display prepared in this organic compound insulator 25 is formed by sputtering. By carrying out patterning of the obtained aluminum film by dry etching, the actuation electrode 19 as a reflector which has the concavo-convex structure of the organic-compound-insulator 25 above-mentioned front face and the same concavo-convex structure was formed.
[0516] In each above-mentioned patterning process, each component is formed in the required configuration based on a design by the technique of photolithography. It used for these photolithography process combining sensitization resin film (resist) spreading / desiccation process, a pattern exposure process, the development process, the resist baking hardening process, a dry etching process and a wet etching process, and the resist exfoliation clearance process.
[0517] Moreover, the concavo-convex structure formed in the reflective display 9 applied the insulating photopolymerization nature resin ingredient, and produced it using a pattern exposure process, a development process, and hardening down stream processing. That is, while the dot-like pattern was formed at the development process, the smoothing layer was formed with the still more nearly same ingredient on this dot pattern. In addition, the above-mentioned organic insulating layer 25 is not formed in the transparency display 10.
[0518] The TFT component 21 is allotted to each pixel by the TFT component substrate produced at the above processes, and each pixel is constituted from a reflective display 9 and a transparency display 10. Here, the TFT component substrate produced two kinds of TFT component substrates shown in the TFT component substrate shown in drawing 23 (a), and drawing 28, and the rate of the transparency display 10 and reflective display 9 was made into the rate as explanation of each liquid crystal display indicated in the gestalt 7 of said operation.
[0519] Next, the making process of a light filter substrate is explained. The making process of a light filter substrate is a substrate from the process which forms the transparence pixel electrode 20 by the side of the TFT component substrate driven by said TFT component 21 on the process which produces the coloring layer (light filter) of R, G, and B, the process which produces a flattening layer on this light filter, and this flattening layer, and the counterelectrode which counters.
[0520] In the gestalt of this operation the above-mentioned light filter substrate As shown in drawing 26 (b) or drawing 29 (b), on a glass substrate 62 Light filter 61 R.61G and 61B of three colors of red (R), green (G), and blue (B) are formed in the shape of a stripe. It produced by forming the smoothing layer 501 on light filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62, so that these light filter 61 R.61G and 61B may be covered, and forming a counterelectrode 502 on it.
[0521] In formation of the above-mentioned light filter substrate, light filter 61 R.61G and 61B carried

out patterning of the resin ingredient which made the optical photopolymer distribute a pigment by the photolithography method, and formed it. In addition, as the manufacture approach of of this light filter 61 R.61G and 61B, approaches other than the approach using distribution of the above-mentioned pigment, for example, an electrodeposition process, a film replica method, a staining technique, etc. can be adopted, and it is not limited especially.
[0522] On light filter 61 R.61G and 61B forming face in the above-mentioned glass substrate 62, the flattening layer 501 applied acrylate resin with high light transmittance, was made to harden it with heat, and was formed. Moreover, the counterelectrode 502 formed on this flattening layer 501 was a counterelectrode which counters the pixel electrode 18 driven by the TFT component 21, made ITO deposit through a mask by sputtering as a transparent electrode, and was formed by considering as a required flat-surface configuration.
[0523] With the gestalt of this operation, the above-mentioned light filter substrate produced two kinds such as the light filter substrate which set up saturation highly to compensate for the transparency display, and the light filter substrate which set up lightness highly to compensate for the reflective display. And the light filter substrate which set up saturation highly was produced to the pattern shown in drawing 26 (a) and drawing 26 (b), and the light filter substrate which set up lightness highly was produced to the pattern shown in drawing 29 (a) and drawing 29 (b).
[0524] Next, in order to produce a liquid crystal display using the TFT component substrate and light filter substrate which were produced as mentioned above, the process which is made to carry out opposite arrangement of these TFT(s) component substrate and the light filter substrate, and produces the liquid crystal cell for liquid crystal impregnation is explained.
[0525] In this process, first, the fusibility polyimide solution has been arranged to the liquid crystal display field in the mutual opposed face (TFT component 21 forming face in the above-mentioned TFT component substrate, and light filter 61 R.61G and 61B forming face in a light filter substrate) in a TFT component substrate and a light filter substrate with offset printing, and the orientation film was formed in it through desiccation and a baking process. Furthermore, orientation processing which decides the direction of liquid crystal orientation to be this orientation film was performed by the rubbing method. In addition, whether the orientation film is a parallel stacking tendency or it is a vertical stacking tendency change with each examples mentioned later.
[0526] Then, while printing the enclosure sealing compound for fixing the above-mentioned TFT component substrate and a light filter substrate while sprinkling the spherical spacer to which particle size was equal to either the TFT component substrate processed in this way or a light filter substrate and enclosing a liquid crystal layer with it on another side, the conductive paste which takes the flow of a counterelectrode 502 from a TFT component substrate side to a light filter substrate side has been arranged.
[0527] And opposite arrangement of TFT component 21 forming face in the above-mentioned TFT component substrate, and light filter 61 R.61G and 61B forming face in a light filter substrate was carried out, alignment of both substrates (a TFT component substrate and light filter substrate) was performed, and the enclosure sealing compound and the ******-strike were stiffened under application of pressure.
[0528] According to the above process, the mother glass substrate 21 by which two or more arrangement was carried out was produced, and further, the liquid crystal cell for liquid crystal impregnation divided this mother glass substrate, and produced the cel for liquid crystal impregnation.
[0529] Then, the liquid crystal cell was produced by applying photopolymerization nature resin in a liquid crystal inlet, and carrying out polymerization hardening by ultraviolet radiation so that the liquid crystal layer which introduced the liquid crystal constituent and was introduced may not touch the above-mentioned liquid crystal non-poured in liquid crystal cell with the open air by the vacuum pouring-in method.
[0530] Next, the short ring part arranged at the TFT component substrate edge was removed so that

each wiring terminal might be short-circuited for the purpose of electrostatic-discharge prevention of the TFT component 21, and the external circuit which drives the TFT component 21 was connected. Furthermore, the liquid crystal display of the active-matrix mold which arranges the back light used as the light source of a transparency display, and is applied to the gestalt of this operation was produced.
[0531] [Example 14]
The liquid crystal display of the active-matrix mold concerning this example is a liquid crystal display of a transparency subject transflective type which used GH method, and is a liquid crystal display which used GH method in the example 1 of the gestalt 1 of said operation for the display.
[0532] The liquid crystal constituent used for this example is prepared according to the example 1 of the gestalt 1 of said operation. That is, in this example, the liquid crystal constituent using the dichroism coloring matter (dichroism coloring matter 12) of a publication was used for said example 1. Moreover, in this example, using the vertical orientation film which has a vertical stacking tendency on the orientation film, orientation processing by rubbing was performed so that uniform vertical orientation might be obtained. In addition, in this example, since GH method which used dichroism coloring matter for the liquid crystal constituent is adopted, the phase contrast compensating plate and the polarizing plate have not been stuck on the above-mentioned liquid crystal cell.
[0533] Moreover, in this example, in order to mainly use a transparency display, light filter 61 R.61G and 61B designed saturation highly like the light filter of the conventional transparency means of displaying, and the light filter substrate has been arranged, as shown in drawing 26 (a) and drawing 26 (b). The TFT component substrate combined with this light filter substrate had large opening 19a for a transparency display, as shown in drawing 23 (a), and the TFT component substrate with which the transparency display 10 was set up widely was used for it.
[0534] In the above-mentioned liquid crystal display concerning this example, as shown in drawing 26 (a) and drawing 26 (b), the actuation electrode 19 in the reflective display 9 Only the part (part which counters with light filter 61 R.61G and 61B in the drawing direction of light filter 61 R.61G and 61B in the actuation electrode 19) It is covered with the same light filter 61 R.61G and 61B as the opening 19a formation field for a transparency display used as the transparency display 10, there is no light filter, and it also has a part for the display which passes the white light.
[0535] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, burning of a back light was always required of this example. However, when [both] a back light was turned on, lightness and a contrast ratio were good and always sufficient display was possible. Moreover, a check by looking of the content of a display is possible also under direct sunlight, and the washout was not produced.
[0536] That is, the color liquid crystal display of the high resolution which the washout which the check of the content of a display is attained since the reflective display 9 changes lightness in proportion to [when an ambient light is strong] an ambient light while a liquid crystal display with high lightness is realized with a back light like the transparency mold liquid crystal display conventional in the environment where it is [of an ambient light] weak in this example, and is produced with a conventional luminescence display and transparency mold liquid crystal display does not arise, and does not have parallax is realizable. Moreover, in this example, the very good reflective display without parallax (double image) was realized.
[0537] [Example 15]
The liquid crystal display of the active-matrix mold concerning this example is a liquid crystal display of a reflective subject transflective type which used GH method, and is a liquid crystal display which used GH method in the example 1 of the gestalt 1 of said operation for the display.
[0538] The liquid crystal constituent is prepared like [this example] the above-mentioned example 14 according to the example 1 of the gestalt 1 of said operation. That is, the liquid crystal constituent using the dichroism coloring matter (dichroism coloring matter 12) of a publication was used for said example 1 also by this example. Moreover, in this example, using the vertical orientation film which has a vertical

stacking tendency on the orientation film, orientation processing by rubbing was performed so that uniform vertical orientation might be obtained. In addition, in this example, since GH method which used dichroism coloring matter for the liquid crystal constituent is adopted, the phase contrast compensating plate and the polarizing plate have not been stuck on the above-mentioned liquid crystal cell.
[0539] Moreover, in this example, in order to mainly use a reflective display, light filter 61 R.61G and 61B were produced so that it might become high lightness from the light filter used for the conventional transparency mold liquid crystal display, and the light filter substrate has been arranged, as shown in drawing 29 (a) and drawing 29 (b). The TFT component substrate combined with this light filter substrate had small opening 19a for a transparency display, as shown in drawing 28, and the TFT component substrate with which the reflective display 9 was set up greatly was used for it.
[0540] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, under lighting and an outdoor daylight environment in the daytime, it was unnecessary and burning of a back light had the reflective display possible for the above-mentioned liquid crystal display concerning this example. In this example, the very good reflective display without parallax (double image) was realized. Moreover, the check by looking of the content of a display was possible by turning on a back light to extent in which observation by the reflected light is impossible, when an ambient light is dark.
[0541] That is, in this example, since light filter 61R.61G, 61B, and the light filter substrate which were set by the reflective display are used as mentioned above, the color display only by the reflected light is possible. For this reason, it is possible to switch off a back light and to use it only by reflective display on the outdoors of the usual indoor lighting or daytime. Moreover, by turning on a back light if needed, even when lighting is dark, visibility can be secured.
[0542] In the liquid crystal display concerning the gestalt of this operation, while having not always turned on the back light and being able to reduce power consumption like the conventional transparency mold liquid crystal display, a washout cannot be started by the reflective display 9, and the transparency display using a back light can be performed if needed.
[0543] [Example 16]
The liquid crystal display of the active-matrix mold concerning this example is a liquid crystal display of a transparency subject transflective type which used the polarization conversion operation of a liquid crystal layer for the display, and is a liquid crystal display which used the polarizing plate method in the example 5 of the gestalt 2 of said operation for the display.
[0544] The liquid crystal constituent used for this example is prepared according to the example 5 of the gestalt 2 of said operation. Moreover, in this example, the phase contrast compensating plate (phase contrast compensating plate 16-17) and the polarizing plate (polarizing plate 14-15) were stuck on the liquid crystal cell (TFT-liquid-crystal panel) into which liquid crystal was injected. Furthermore, in this example, by the rubbing method, orientation processing was performed on the orientation film of a parallel stacking tendency so that a rubbing crossed axes angle might become 250 degrees.
[0545] Moreover, in this example, like said example 14, in order to mainly use a transparency display, light filter 61 R.61G and 61B were designed in the same transparency color as the light filter of the conventional transparency means of displaying, and the light filter substrate has been arranged, as shown in drawing 26 (a) and drawing 26 (b). The TFT component substrate combined with this light filter substrate had large opening 19a for a transparency display, as shown in drawing 23 (a), and the TFT component substrate with which the transparency display 10 was set up widely was used for it.
[0546] As shown in drawing 26 (a) and drawing 26 (b), in the above-mentioned liquid crystal display concerning this example the actuation electrode 19 of the reflective display 9 Only the part (part which counters with light filter 61 R.61G and 61B in the drawing direction of light filter 61 R.61G and 61B in the actuation electrode 19) It is covered with the same light filter 61 R.61G and 61B as the opening 19a formation field for a transparency display used as the transparency display 10, there is no light filter, and it also has a part for the display in which the white light is reflected.

[0547] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, burning of a back light was always required of this example. However, when [both] a back light was turned on, lightness and a contrast ratio were good and always sufficient display was possible. Moreover, a check by looking of the content of a display is possible also under direct sunlight, and the washout was not produced.
[0548] That is, at this example, in the weak environment of an ambient light, in order that the reflective display 9 may change lightness in proportion to an ambient light when an ambient light is strong while a liquid crystal display with high lightness is realized with a back light like the conventional transparency mold liquid crystal display, the check of the content of a display is attained and it turns out that the washout produced with a conventional luminescence display and a conventional transparency mold liquid crystal display does not arise. Moreover, in this example, the very good reflective display without parallax (double image) was realized.
[0549] [Example 17] The liquid crystal display of the active-matrix mold concerning this example is a liquid crystal display of a reflective subject transflective type which used the polarization conversion operation of a liquid crystal layer for the display, and is a liquid crystal display which used the polarizing plate method in the example 5 of the gestalt 2 of said operation for the display.
[0550] The liquid crystal constituent is prepared like [this example] the above-mentioned example 16 according to the example 5 of the gestalt 2 of said operation. Moreover, this example also stuck the phase contrast compensating plate (phase contrast compensating plate 16-17; example 5 reference) and the polarizing plate (polarizing plate 14-15) on the liquid crystal cell (TFT-liquid-crystal panel) into which liquid crystal was injected. In this example, by the rubbing method, orientation processing was performed on the orientation film of a parallel stacking tendency so that a rubbing crossed axes angle might become 250 degrees.
[0551] Moreover, in this example, like said example 15, in order to mainly use a reflective display, light filter 61 R.61G and 61B were produced so that it might become high lightness from the light filter used for the conventional transparency mold liquid crystal display, and the light filter substrate has been arranged, as shown in drawing 29 (a) and drawing 29 (b). The TFT component substrate combined with this light filter substrate had small opening 19a for a transparency display, as shown in drawing 28, and the TFT component substrate with which the reflective display 9 was set up greatly was used for it.
[0552] Thus, the status signal was inputted into the produced above-mentioned liquid crystal display, and visual observation was performed. Consequently, under lighting and an outdoor daylight environment in the daytime, it was unnecessary and burning of a back light had the reflective display possible for the above-mentioned liquid crystal display concerning this example. In this example, the very good reflective display without parallax (double image) was realized. Moreover, the check by looking of the content of a display was possible by turning on a back light to extent in which observation by the reflected light is impossible, when an ambient light is dark.
[0553] That is, in this example, since light filter 61R.61G, 61B, and the light filter substrate which were set by the reflective display are used as mentioned above, the color display only by the reflected light is possible. For this reason, it is possible to switch off a back light and to use it only by reflective display on the outdoors of the usual indoor lighting or daytime. Moreover, by turning on a back light if needed, even when lighting is dark, visibility can be secured.
[0554] In the liquid crystal display concerning the gestalt of this operation, while having not always turned on the back light and being able to reduce power consumption like the conventional transparency mold liquid crystal display, a washout cannot be started by the reflective display 9, and the transparency display using a back light can be performed if needed.
[0555] As mentioned above, it was shown that the active-matrix liquid crystal display of the high resolution which realizes the liquid crystal display method shown in the gestalt 1 of said operation and the gestalt 2 of operation is realizable with the above-mentioned examples 14-17 according to the gestalt of this operation.

[0556] In addition, although the liquid crystal display with which liquid crystal thickness differs by the reflective display 9 and the transparency display 10 was produced by the organic compound insulator 25 (equivalent to an insulator layer 11) to the active-matrix substrate (TFT component substrate) in the above-mentioned examples 14-17, it cannot be overemphasized that the same effectiveness is expectable with the liquid crystal display principle by the other invention in this application.
[0557] [The gestalt 10 of operation]
The gestalt of this operation explains below modification of the brightness of the back light used for the liquid crystal display concerning this invention.
[0558] There are mainly three kinds of objects which change the brightness of a back light. The 1st object is reservation of visibility. As shown in the gestalt 8 of said operation, people's perception lightness is prescribed by adaptation luminance and the brightness of the screen. Therefore, as shown in the gestalt 8 of said operation, it is desirable [it is effective to change the brightness of a back light according to the perception lightness of people's eyes according to adaptation luminance, and], in order to realize the display of good visibility to change the brightness of the screen by controlling the brightness of a back light according to adaptation luminance so that perception lightness may be set to 10 or more brils and less than 30 brils. That is, the above-mentioned back light serves as the screen brightness modification means. Thereby, the visibility in the situation which the transparency display has mainly contributed to the display is improvable. Here, since the value of the perception lightness specified in the gestalt 8 of said operation assumes the brightness of the screen proportional to the adaptation luminance to which people have adapted themselves, it can obtain a good display in general by changing the brightness of a back light according to the above-mentioned perception lightness.
[0559] The 2nd object is reduction of power consumption. There is a case even if it turns on a back light and puts out the light, so that it may not have big effect on visibility. For example, a liquid crystal display is a transflective type liquid crystal display, and the illuminance of the illumination light which illuminates this liquid crystal display from a perimeter is fully high, and it is the case where the brightness of the screen is mainly maintained by the reflective display. In such a case, it is desirable not to influence the brightness of the screen and to switch off a back light even if, for the cutback of power consumption in such a case, even if the brightness in a transparency display is high.
[0560] When the color display is performed only to either among the reflective display and the transparency display, the 3rd object is completing intentionally a busy condition to which a color display and monochrome display are changed by burning of a back light, and is giving two or more functions to one liquid crystal display.
[0561] For example, since it becomes possible to take the resolution of a reflective display higher than the transparency display which displays one monochrome unit by two or more pixels using a light filter when do not arrange a light filter to a reflective display, but monochrome display is performed, a light filter is arranged only to a transparency display and color display is performed, a reflective display carries out monochrome display of high resolution, and although it is not high, it is possible [display / transparency / resolution] in a color display. Moreover, a light filter is able to be used for reverse only in a reflective display. In this case, it becomes possible to give the function of an application which is different with one liquid crystal display. Therefore, it is possible to change the content of a display greatly according to the burning condition by changing a color display and monochrome display by burning of a back light, or changing the luminescent color.
[0562] As mentioned above, the brightness of a back light is controllable by the suitable signal each time according to the purpose of use or an operating condition. When making it change according to the adaptation luminance which mentioned the brightness of a back light above, the brightness of the above-mentioned back light can be controlled according to visual environment, such as an illuminance of the lighting which carries out incidence to the screen for the purpose of improvement in visibility, and a class of display of a liquid crystal display.
[0563] It is desirable to control the burning condition of a back light of turning on a back light weakly in

order to switch off a back light, and to avoid dazzle when an illuminance is low when an illuminance is high when controlling the brightness of the above-mentioned back light by the illuminance, and turning on a back light strongly when an illuminance is the medium.

[0564] In this case, if the signal from the various external devices connected to the liquid crystal cell or the liquid crystal display, timer control, etc. perform existence of burning of a back light, and control of brightness according to a user's condition etc., unnecessary power consumption is reducible.

[0565] Furthermore, the cutback of the power consumption of the whole device and offer of the good display to a user can be reconciled by the thing made only for a fixed period to turn on a back light when a user adds a certain actuation to the device equipped with the above-mentioned liquid crystal display on the occasion of control of the brightness of a back light. In addition, the brightness of a back light may be controlled by other various signals in addition to the illuminance of the lighting which carries out incidence to the screen as described above.

[0566] Moreover, it is dramatically effective, when controlling the liquid-crystal orientation in the existence, brightness or a reflective display, and the transparency display of burning of a back light by the signal which the user inputted into the touch panel (press coordinate detection blocking force means) arranged in piles to the screen of a liquid crystal cell or attaining the object which also mentioned above making it the signal which demands a certain caution from other users interlocked with, and controlling the brightness of a back light. Thus, the liquid crystal display in which coexistence with visibility and a low power is possible can be obtained by controlling the brightness of the screen from the liquid crystal cell outside.

[0567] [The gestalt 11 of operation]

The gestalt of this operation explains the concrete configuration of the liquid crystal display concerning this invention at the time of using a touch panel (press coordinate detection blocking force means) as an information input means in the pocket device which are the main fields of the invention of the liquid crystal display of this invention. In addition, the same number is given to the component which has the function as the gestalten 1-10 of said operation of explanation same for convenience, and the explanation is omitted.

[0568] With the gestalt of this operation, the transflective type liquid crystal display of input unit one apparatus was produced for the touch panel in piles to the liquid crystal display of the example 17 in the gestalt 9 of said operation. The configuration of the liquid crystal display of input unit one apparatus concerning the gestalt of this operation is shown in drawing 32. In addition, since it is the same as that of the example 17 in the gestalt 9 of said operation, and the example 5 of the gestalt 2 of said operation, the configuration of the fundamental configuration of those other than touch panel 71 in the liquid crystal display concerning the gestalt of this operation, i.e., a liquid crystal cell, and a back light 13 is omitted here.

[0569] The above-mentioned touch panel 71 is equipped with the movable substrate 73 with which the transparent electrode layer 72 was formed, and the support substrate 75 with which the transparent electrode layer 74 was formed. With the spacer which is not illustrated so that not each transparent electrode layers may contact in an energization condition, these movable substrates 73 and the support substrate 75 have a predetermined gap, and opposite arrangement is carried out while the transparent electrode layer 72 and the transparent electrode layer 74 counter mutually. Thereby, although the transparent electrode layer 72 prepared in the above-mentioned movable substrate 73 and the transparent electrode layer 74 prepared in the above-mentioned support substrate 75 do not contact mutually in a normal state, it contacts mutually in the directed part by directing the above-mentioned movable substrate 73 with a finger or a pen (press). For this reason, the above-mentioned touch panel 71 functions as an input unit by detecting the contact location (coordinate location) of the above-mentioned transparent electrode layer 72 and the transparent electrode layer 74 by the thrust applied to the movable substrate 73.

[0570] The above-mentioned touch panel 71 is sticking the phase contrast compensating plate 16 and a

polarizing plate 14 on the above-mentioned movable substrate 73, and is arranged in one with the above-mentioned phase contrast compensating plate 16 and the polarizing plate 14 between the phase contrast compensating plate 16 and the substrate 4 of a liquid crystal cell. In the gestalt of this operation, in order to acquire the effectiveness of the polarizing plate in said example 17 with the polarizing plate 14 on which it was stuck on the touch panel 71, the movable substrate 73 and the support substrate 75 which constitute the above-mentioned touch panel 71 are produced with the ingredient without a birefringence.

[0571] Moreover, with the gestalt of this operation, the thrust of touch panel 71 HE considered as the configuration which does not get across to a liquid crystal cell, without using a thrust buffer member by preparing a gap between the support substrate 75 of a touch panel 71, and the substrate 4 of a liquid crystal cell, and keeping this gap constant in order to give the thrust transfer prevention effectiveness to this liquid crystal display between a touch panel 71 and the substrate 4 of a liquid crystal cell for the above-mentioned liquid crystal display.

[0572] Thus, as for the liquid crystal display of constituted above-mentioned input-device one apparatus, it is possible by changing the brightness of a back light 13 with the signal of a touch panel 71 to switch off a back light 13, when the user is not observing the display, and to make a back light 13 turn on with the input of the information on a touch panel 71. Therefore, according to the gestalt of this operation, the liquid crystal display which was compatible in a good display and reduction of power consumption was realizable. Moreover, since according to the gestalt of this operation absorption by the polarizing plate 14 can also absorb the unnecessary reflected light by the touch panel 71 and can reduce this unnecessary reflected light by arranging in the order which mentioned above the above-mentioned polarizing plate 14, the touch panel 71, and the liquid crystal cell, visibility can be improved.

[0573] As mentioned above, the invention-in-this-application person etc. found out the conclusion that it was because the cause of the trouble of the conventional liquid crystal display is set up similarly [in any / of the above-mentioned GH method and a polarizing plate method / case / the orientation of the liquid crystal layer in this time of day / in a transparency display and a reflective display].

[0574] Here, the orientation of a liquid crystal layer shall show not only orientation bearing of an average of the liquid crystal molecule in a point with a liquid crystal layer but the coordinate dependency of average orientation bearing to the coordinate taken in the direction of a normal of the layer of a layer-like liquid crystal layer.

[0575] Namely, the substrate of a couple with which the orientation means (for example, orientation film) was given to the front face on which the 1st liquid crystal display counters, It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrates of this couple. the orientation device (for example, the electrode which produces electric field which are arbitrary, give an electrical potential difference which is different to a different field used for the display in the above-mentioned liquid crystal layer, or are different --) for making it take at least two kinds of different orientation conditions it being arbitrary and simultaneous to a different field used for the display in the above-mentioned liquid crystal layer The orientation film by which was arbitrary, and was respectively prepared in a different field used for the display in the impressed electrical potential difference or the above-mentioned liquid crystal layer, and orientation processing was carried out in at least two kinds of the different bearings, Or the insulator layer and substrate which were formed so that it might have at least two kinds of different thickness in the field used for the display in the above-mentioned liquid crystal layer, A specific liquid crystal ingredient, the liquid crystal layer system formed so that it might drive independently respectively, A polarizing plate, phase contrast compensating plates, or those combination are provided. And a reflective means (for example, the reflective film and a reflector) is allotted to at least one field among the fields which show a different orientation condition in the above-mentioned liquid crystal layer, and the field which shows an orientation condition different the account of a top has the configuration used for the reflective display which performs a reflective display, and the transparency display which performs a transparency display.

[0576] According to the above-mentioned configuration, by having the orientation condition that liquid crystal orientation differs simultaneously, in using coloring matter, such as dichroism coloring matter, for a display and using the amount of absorption of light (absorption coefficient), and an optical anisotropy, it becomes possible to change the magnitude of the amount of modulations of each optical physical quantity called phase contrast for every field where liquid crystal orientation differs. For this reason, according to the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity according to the orientation condition of a liquid crystal layer can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned configuration, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired even when an ambient light is strong. For this reason, according to the above-mentioned configuration, it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0577] Furthermore, the 2nd liquid crystal display has the configuration whose above-mentioned orientation device is the content rewriting means of a display which rewrites the content of a display in connection with the passage of time in the 1st liquid crystal display.
[0578] The 1st liquid crystal display of the above can be obtained without according to the above-mentioned configuration, the same means' being able to realize the content rewriting means of a display, and the above-mentioned orientation device, and adding a new configuration. In this case, a possible thing cannot be overemphasized even if it is the various means used for electrical-potential-difference impression of the electric liquid crystal orientation control means used widely now, i.e., an electrode etc., in order to rewrite the content of a display in connection with the passage of time as the above-mentioned content rewriting means of a display used in order to take two or more conditions that liquid crystal orientation differed. Two or more fields which have the orientation condition that liquid crystal orientation differs can be prepared in a liquid crystal layer by using an electrode which is different by the transparency display and the reflective display in this case, or changing the electrical potential difference itself by the transparency display and the reflective display.
[0579] Moreover, when extent of the amount of modulations of each optical physical quantity, such as the amount of absorption of light and phase contrast by the optical anisotropy, is independently changed by the reflective display and the transparency display, Even when the direction of orientation of the liquid crystal by impression of an electrical potential difference is almost the same in the whole field for using for the display of a liquid crystal layer, in the field in which the liquid crystal thickness of a liquid crystal layer differs, it has substantially the same operation as the case where the direction of orientation of a liquid crystal layer is changed in this field. Coloring matter, such as dichroism coloring matter, is used especially, in the polarizing plate method using GH method using the absorption of light, a birefringence, or a rotatory-polarization phenomenon, each of each phenomena of the absorption of light produced in a liquid crystal layer and a birefringence is phenomena accompanying propagation of light, and each phenomenon has relevance between the propagation distance of the light in a liquid crystal layer, and extent of those phenomena. Furthermore, display light passes a liquid crystal layer twice by round trip in a reflective display, in order to pass a liquid crystal layer only at once in a transparency display, when liquid crystal orientation is almost the same and liquid crystal thickness is similarly set up by the reflective display and the transparency display, sufficient lightness or a sufficient contrast ratio are not obtained and said technical problem is not solved.
[0580] Then, the substrate of a couple with which the orientation means (for example, orientation film) was given to the front face on which the 3rd liquid crystal display counters, It is the liquid crystal display equipped with the liquid crystal display component which has the liquid crystal layer pinched between the substrates of this couple. While each field where the field used for the display in the above-

mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display A reflective means (for example, the reflective film and a reflector) is allotted to a reflective display at least, and the liquid crystal thickness of the above-mentioned reflective display has the configuration smaller than a transparency display.

[0581] According to the above-mentioned configuration, the permeability or reflection factor based on magnitude of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned configuration, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise the visibility in the case of being dark in a perimeter, good visibility can be acquired even when an ambient light is strong. For this reason, according to the above-mentioned configuration, it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.

[0582] The 4th liquid crystal display has the configuration to which the orientation means is given so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of a up Norikazu pair in the orientation of the liquid crystal layer interface which touches it in which [the above 1st - / 3rd] liquid crystal display.

[0583] Thus, as a means for having the orientation condition that liquid crystal orientation differs simultaneously, it is given to the interface on the substrate which touches for example, the above-mentioned liquid crystal layer in addition to said content rewriting means of a display, for example, and the orientation film by which orientation processing was carried out so that at least two kinds of different directions of orientation might be given to the orientation of the liquid crystal layer interface which touches it can be used. By thus, the thing performed for the orientation means so that at least two kinds of different directions of orientation may be given to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in the above-mentioned substrate front face in the orientation of the liquid crystal layer interface which touches it In the field to which the above-mentioned liquid crystal layer is the arbitration for using for the display in this liquid crystal layer, and differ at the time of electrical-potential-difference impression, at least two kinds of different orientation conditions can be shown simultaneously, and a reflective display and a transparency display can be performed in the field in which the orientation conditions in the above-mentioned liquid crystal layer differ.

[0584] In this case, both the orientation of the liquid crystal which determines an optical property, and the orientation change at the time of impressing an electrical potential difference can be changed by changing the elevation angle over the substrate of liquid crystal orientation, and its azimuth, and it becomes possible to perform the display which was suitable for each display by the reflective display and the transparency display.

[0585] In the ratio of a reflective display and a transparency display, the optimal ratio for carrying out a good display exists by the displays want, such as whether according to the means and the orientation device mentioned above, a good display is realizable by both the reflective display and the transparency display, but a color display (color display) is performed or monochrome display performs, it displays by indicating it a subject by reflective, or to display a transparency display by carrying out as a subject.

[0586] That is, the 5th liquid crystal display has the configuration whose percentages that the area of the reflective display to the area of the sum total of the above-mentioned reflective display and a transparency display occupies are 30% or more and 90% or less in which [the 1st - / 4th] liquid crystal display.

[0587] According to the above-mentioned configuration, when performing color display by both the above-mentioned reflective display and the transparency display, a good display can be performed by

both the above-mentioned reflective display and the transparency display.

[0588] Moreover, it is desirable for the content of a display not to be reversed by the reflective display from a viewpoint and transparency display of visibility. It is for the contrast ratio of a display with the reinforcement of an ambient light being large, and changing this, if a lighting environment changes or the content of a display is reversed by the reflective display and the transparency display in a situation with difficult prediction of change of a lighting environment, and fluctuation of such a contrast ratio serves as the same phenomenon as a washout, and causes large aggravation of visibility from the point of visibility.

[0589] Then, it is dramatically important that a reflective display displays clear display simultaneously when a transparency display is clear display, and a reflective display displays a dark display simultaneously when a transparency display is a dark display, when securing visibility.

[0590] For this reason, in which [the 1st - / 5th] liquid crystal display, when the above-mentioned transparency display is clear display, a reflective display serves as clear display simultaneously, and the 6th liquid crystal display has simultaneously the configuration in which a reflective display serves as a dark display, when the above-mentioned transparency display is a dark display.

[0591] A reflective display is able for the 6th liquid crystal display of the above to be having the configuration of the 1st or 3rd liquid crystal display of the above, according to the above-mentioned configuration, for a reflective display to consider as clear display simultaneously, when the above-mentioned transparency display is clear display, and to consider as a dark display simultaneous, when the above-mentioned transparency display is a dark display. Especially, according to the above-mentioned liquid crystal display, if it remains as it is, even if it is the case where the content of a display is reversed by the reflective display and the transparency display, said content rewriting means of a display can be used for said orientation device, and a display can be easily arranged by controlling rewriting of the content of a display by the reflective display and the transparency display according to an individual, for example. Therefore, according to the above-mentioned configuration, good visibility is securable.

[0592] Moreover, the 7th liquid crystal display has the configuration which the above-mentioned liquid crystal layer becomes from the liquid crystal constituent which comes to mix the coloring matter which has dichroism in liquid crystal in which [the 1st - / 6th] liquid crystal display.

[0593] According to the above-mentioned configuration, when the above-mentioned liquid crystal layer consists of a liquid crystal constituent which comes to mix in liquid crystal the coloring matter which has dichroism, the amount of absorption of light can be rationalized by the reflective display and the transparency display.

[0594] Moreover, it is also effective to use the method which uses a birefringence and a rotatory-polarization phenomenon for a display by both the reflective display and the transparency display, using a polarizing plate as means of displaying for performing a good display.

[0595] For this reason, the 8th liquid crystal display has the configuration by which the polarizing plate is arranged among the substrates of a up Norikazu pair at the non-contact side side with the liquid crystal layer in one [at least] substrate in which [the 1st - / 7th] liquid crystal display.

[0596] According to the above-mentioned configuration, by the reflective display and the transparency display, a birefringence can be rationalized and a good display can be performed. In order to use a polarizing plate method for a reflective display and to secure sufficient display in a transparency display with the 3rd liquid crystal display of the above at this time, it is required not only for a screen side but the incidence side of the light of a transparency display to have a polarizing plate.

[0597] Moreover, in a reflective display, as for the variation of the phase contrast of the light from which the orientation change by the electrical potential difference of a liquid crystal layer is also hung down in the 8th liquid crystal display of the above, it is desirable to set up so that it may be suitable for the light which goes and comes back to a liquid crystal layer, and to set up so that it may be suitable for the light which penetrates a liquid crystal layer in a transparency display, when changing a display.

[0598] The 9th liquid crystal display is equipped with an electrical-potential-difference impression

means (for example, electrode) to impress an electrical potential difference to the above-mentioned liquid crystal layer, in the 8th liquid crystal display. For this reason, this electrical-potential-difference impression means The phase contrast of the display light on the reflective means of the reflective display at the time of electrical-potential-difference impression It has the configuration which impresses an electrical potential difference so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of clear display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of clear display and a dark display.
[0599] The liquid crystal orientation in the above-mentioned liquid crystal layer in this case, specifically As shown in the 10th liquid crystal display, the above-mentioned liquid crystal layer between the substrates of a up Norikazu pair [whether twist orientation is carried out on the twist square of 60 degrees or more and 100 degrees or less, and] Or as shown in the 11th liquid crystal display, it is desirable that the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of a up Norikazu pair on the twist square of 0 times or more and 40 degrees or less.
[0600] The above-mentioned liquid-crystal layer can use change of the polarization near the rotatory polarization according to a twist of the orientation of liquid crystal for a display in the liquid-crystal layer of a transparency display with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 60 degrees or more and 100 degrees or less, and it can use change of the polarization by control with the rotatory polarization and a retardation for a display in a reflective display between the substrates of a up Norikazu pair.
[0601] Moreover, the above-mentioned liquid crystal layer can use both change of a retardation for a display also in the liquid crystal layer of a reflective display also in the liquid crystal layer of a transparency display between the substrates of a up Norikazu pair with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 0 times or more and 40 degrees or less.
[0602] Therefore, the 10th liquid crystal display has the configuration in which the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of a up Norikazu pair on the twist square of 60 degrees or more and 100 degrees or less.
[0603] The 11th liquid crystal display has the configuration in which the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of a up Norikazu pair on the twist square of 0 times or more and 40 degrees or less.
[0604] According to the above 9th - the 11th liquid crystal display, by the reflective display and the transparency display, the variation of phase contrast which was respectively suitable for the reflective display or the transparency display can be obtained, and the change of the display with clear display and a dark display is attained.
[0605] Moreover, in which [the above 1st - / 6th, 8th, or 9th] liquid crystal display, even if orientation change of liquid crystal is only modification of bearing in a field parallel to a substrate, sufficient display is possible for it.
[0606] That is, in which [the 1st - / 6th, 8th, or 9th] liquid crystal display, the above-mentioned liquid crystal display component is at least one side among the above-mentioned reflective display and a transparency display, and the 12th liquid crystal display has the configuration which displays by changing the orientation condition of a liquid crystal layer by making parallel rotate a liquid crystal molecule to a substrate.
[0607] Furthermore, according to the following configurations, the lowness of the efficiency for light utilization of an in plane switching method is conquerable by using positively for a display the insufficiency of the liquid crystal orientation leading to the low light transmittance which is the technical problem of the conventional in plane switching method as a reflective display.
[0608] That is, the 13th liquid crystal display has the configuration in which the above-mentioned liquid crystal display component equips the above-mentioned liquid crystal layer with an electrical-potential-

difference impression means to produce electric field in the field inboard of a substrate, among the above-mentioned reflective display and the transparency display corresponding to either in the 12th liquid crystal display.

[0609] Moreover, although the orientation of a liquid crystal layer may be parallel orientation that to a display used, it may be vertical orientation as for which liquid crystal is carrying out orientation vertically to the substrate. [than before] [more]

[0610] The 14th liquid crystal display has the configuration equipped with the orientation film which has a vertical stacking tendency to the field at least corresponding to one side among the above-mentioned reflective display [in / on which / the 1st - / 9th, 12th, or 13th / liquid crystal display and / in one / among substrates of up Norikazu pair / at least / substrate / the contact surface with the above-mentioned liquid crystal layer], and the transparency display.

[0611] Thus, the above-mentioned substrate is equipped with the orientation film which has a vertical stacking tendency, and there is an advantage to which the contrast ratio of a display becomes good in being the vertical orientation as for which liquid crystal is carrying out orientation vertically to the substrate, and moreover, in the 1st - the 9th, 12th, or 13th liquid crystal display, when performing a good display, it acts effectively.

[0612] Moreover, the 15th liquid crystal display is set to which [the 1st - / 14th] liquid crystal display. One [at least] substrate equips the field corresponding to a reflective display with an insulator layer at least among the above-mentioned reflective display and a transparency display among the substrates of a up Norikazu pair. This insulator layer The thickness has the configuration currently formed so that the direction of the field corresponding to the above-mentioned reflective display may become thicker than the field corresponding to a transparency display.

[0613] That is, the above-mentioned liquid crystal display has an insulator layer on one [which pinches a liquid crystal layer / at least] almost smooth substrate, this insulator layer is a field corresponding to a transparency display, it is formed so that thickness may become thin rather than the field corresponding to a reflective display, or the insulating layer is formed only in the field corresponding to a reflective display, and the insulator layer is not formed in the field corresponding to a transparency display.

[0614] According to the above-mentioned configuration, the field used for the display in a liquid crystal layer can obtain easily the liquid crystal display (namely, liquid crystal display with which liquid crystal thickness differs by the reflective display and the transparency display) which has at least two kinds of different liquid crystal thickness.

[0615] Moreover, the above-mentioned insulator layer can be impressed to a liquid crystal layer without loss of the electrical potential difference which drives a liquid crystal layer by forming the electrode for a display in the field where it not only acts as an adjustment means of liquid crystal thickness, but the above-mentioned insulator layer touches a liquid crystal layer in a reflective display.

[0616] In this case, the film which has light reflex nature as a reflective means in the substrate by the side of the screen and the substrate by which opposite arrangement was carried out is formed. It is effective that the film which has this light reflex nature has concavo-convex structure as a mirror plane nature prevention means of the reflective display which does not spoil resolution, without spoiling the display engine performance of a transparency display. The above-mentioned insulator layer can form easily the film which has the above-mentioned light reflex nature which has concavo-convex structure by having the membranous concavo-convex structure of having the above-mentioned light reflex nature, and the same concavo-convex structure.

[0617] Moreover, when performing color display using each above-mentioned liquid crystal display, the design of not only a liquid crystal layer but a light filter layer important for coloring is important. According to examination of invention-in-this-application persons, there are two kinds of main activity gestalten of a transflective type liquid crystal display.

[0618] By one usually mainly using a transparency display in an activity, and using a reflective display

additionally Prevent the washout under the very strong lighting environment of an ambient light, and it compares with a luminescence mold display or the liquid crystal display of only a transparency display. It is the activity gestalt which secures the large versatility of an usable lighting environment and which indicates it a subject by transparency. Another usually, in an activity, under the weak environment of lighting taking advantage of the property of reflective display that there is little power consumption By turning on and using the lighting system called the so-called back light, it is the activity gestalt which secures the large versatility of an usable environment like a previous activity gestalt and which indicates it a subject by reflective.
[0619] In a previous activity gestalt (activity gestalt which indicates it a subject by transparency), among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair, at least, it excels in visibility by arranging the light filter which has transparency color to the field corresponding to a transparency display, and high resolution color display is possible and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0620] And especially the thing for which the light filter which has transparency color is arranged on a transparency display at least, and the light filter which arranges the light filter which has the same lightness as the light filter arranged on the transparency display in a part of reflective display [at least], not using a light filter on a reflective display, or has the high transparency color of lightness rather than it is arranged on each pixel when performing color display in this way is effective.
[0621] When this is because lightness runs short if the light filter of a transparency display is used for a reflective display as it is when performing color display and a reflective display also performs color display By arranging the light filter which establishes the field which does not use a light filter in a reflective display, or has the high transparency color of lightness rather than a transparency display in a reflective display It is because lightness is suppliable, color display becomes possible and a reflection factor required for a reflective display can be secured also to a reflective display.
[0622] And in a reflective display, if it takes into consideration that display light passes a light filter twice, it is desirable to arrange the light filter which has the high transparency color of lightness rather than a transparency display on a reflective display.
[0623] Moreover, in the activity gestalt which indicates it a subject by transparency, when considering as the configuration which has the field which does not prepare a light filter in a reflective display, a display voltage signal required for a transparency display is the signal for which it was suitable to the color display, and a display voltage signal required for a reflective display is the signal it was suitable to monochrome display in the example which is not used at all in a light filter to a reflective display. Therefore, although the rate which the pixel of each color contributes to lightness when considering as the configuration which does not prepare a light filter in a reflective display is proportional to the luminous transmittance of each color in a transparency display, since it becomes equal, when considering as the configuration which does not prepare a light filter in a reflective display, with a reflective display, it is desirable [it is each color and] in changing the area of the field which does not perform in the color display of a reflective display according to the luminous transmittance of each color of the light filter used for a transparency display.
[0624] Namely, the 16th liquid crystal display is set to which [the 1st - / 15th] liquid crystal display. To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the light filter which has transparency color is arranged, and constitute the above-mentioned viewing area It has the configuration on which the light filter arranged on the field corresponding to the transparency display in the above-mentioned substrate and the light filter which has the same lightness are arranged.
[0625] While according to the above-mentioned configuration lightness is compensated and color display becomes possible also not only to a transparency display but to a reflective display, a reflection factor

required for a reflective display can be secured, it can be indicated a subject by transparency, and the transflective type liquid crystal display in which color display is possible can be offered.
[0626] Moreover, the 17th liquid crystal display is set to the 1st – the 15th liquid crystal display. To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair To a part of field [at least] corresponding to a reflective display among the fields which the light filter which has transparency color is arranged, and constitute the above-mentioned viewing area It has the configuration on which the light filter which has transparency color with lightness higher than the light filter arranged on the field corresponding to the transparency display in the above-mentioned substrate is arranged.
[0627] When performing color display, while according to the above-mentioned configuration lightness is compensated and color display becomes possible also not only to a transparency display but to a reflective display, a reflection factor required for a reflective display can be secured, it can be indicated a subject by transparency, and the transflective type liquid crystal display in which color display is possible can be offered. In this case, in a reflective display, display light passes a light filter twice. For this reason, by arranging the light filter which has transparency color with lightness higher than the light filter arranged on the field corresponding to a reflective display to the field corresponding to the transparency display in the above-mentioned substrate, lightness can be raised more and better color display can be performed.
[0628] Furthermore, the 18th liquid crystal display is set to which [the 1st – / 17th] liquid crystal display. The inside of the field which constitutes the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair, It has the configuration with which the area of the field which the light filter which has transparency color is arranged, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned light filter is set as the field corresponding to a transparency display at least.
[0629] According to the above-mentioned configuration, the rate which the pixel of each color contributes to lightness can be changed with the luminous transmittance of each color, consequently a good display can be realized.
[0630] Moreover, it sets in the second activity gestalt (activity gestalt which indicates it a subject by reflective). By arranging the light filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of a up Norikazu pair It excels in visibility, and high resolution color display is possible, and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0631] And especially the thing for which the light filter which arranges at least the light filter which has transparency color on a reflective display, and performs a color display to each pixel, has the same saturation as the light filter arranged on the reflective display at a part of transparency display [at least] in a transparency display, not using a light filter, or has the high transparency color of saturation rather than it is arranged when performing color display in this way is effective.
[0632] In the activity gestalt which indicates it a subject by reflective, in a transparency display, when monochrome display is performed not using a light filter, since the permeability of light rises, it is possible to set up a transparency display still smaller. Thereby, the area of a reflective display can be secured more greatly and a better display can usually be obtained in the reflective display at the time of an activity.
[0633] Moreover, in the activity gestalt which indicates it a subject by reflective, the contribution to the lightness of monochrome display of the transparency display in each pixel can be set up proper in consideration of luminous transmittance by changing the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of each color of the light filter used for a reflective display.

Since it became timeout time, translation result display processing is stopped.